

Change Detection Using Landsat Time Series Data

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What are we striving for with our change detection investigations?

- Characterize land cover status and trends across large regions (using the Landsat data archive)
- A major focus of this work is to describe changes in **condition** in vegetation communities
- Ultimately looking to describe and understand the linkages between vegetation changes, which are often subtle and gradual, with other events (e.g. climate variables)



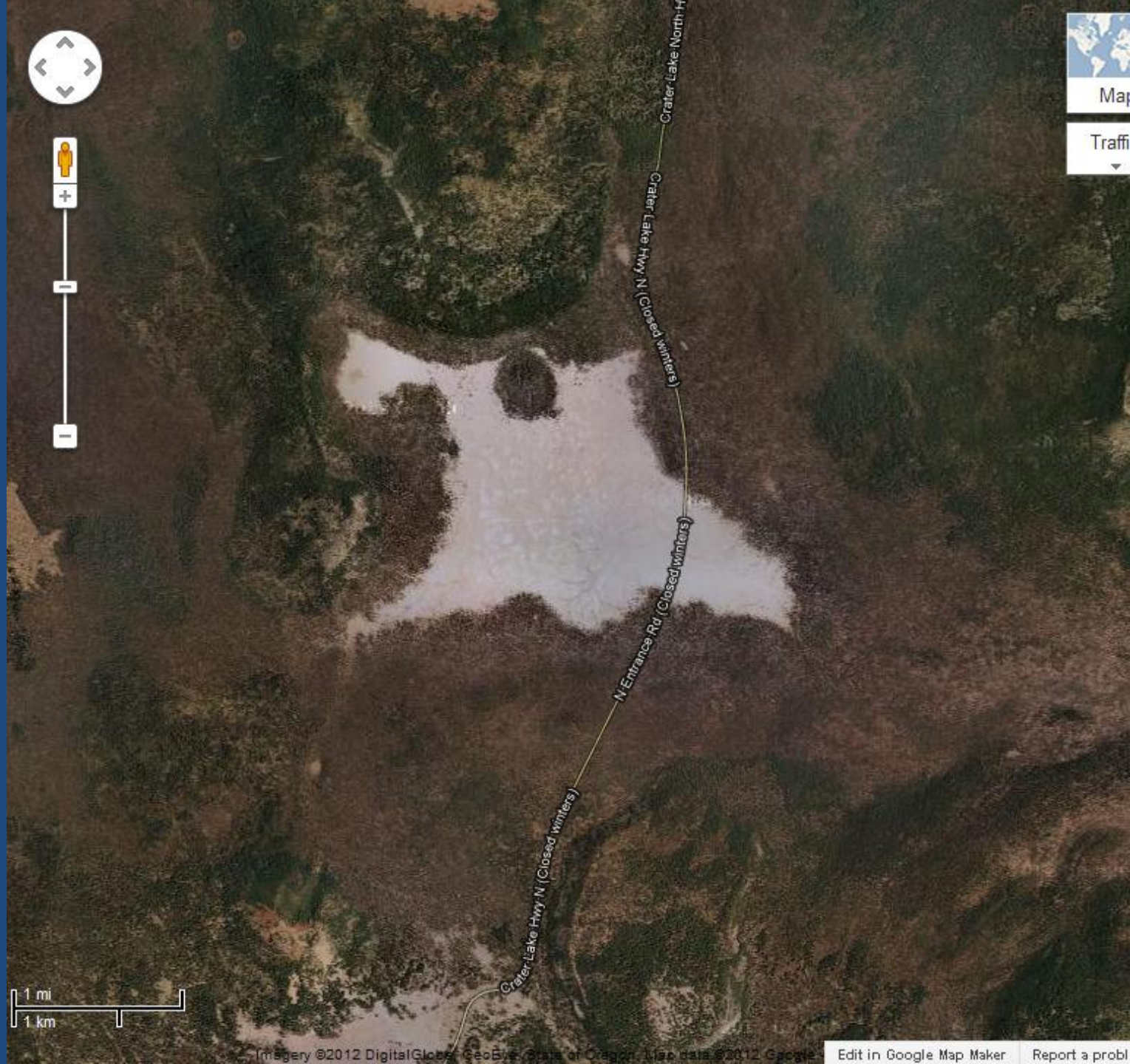
Forest damage caused by
western spruce budworm



Forest succession (encroachment
of conifers on “Pumice Desert”)

Pumice Desert
Crater Lake
National Park
Oregon

Google
Earth



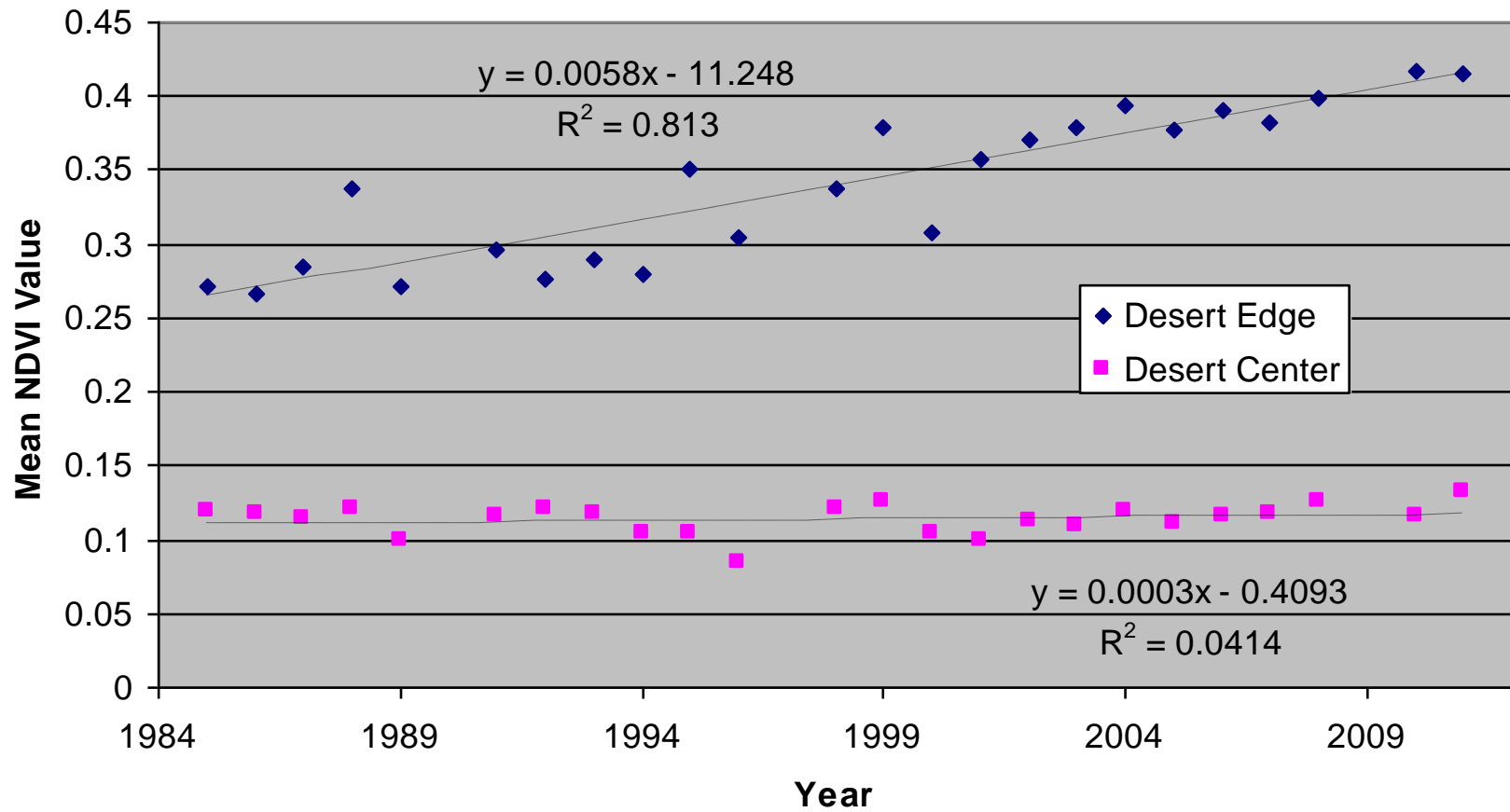
Pumice Desert;
Crater Lake
National Park
Oregon

NDVI Trends;
25 years of
Landsat
Imagery

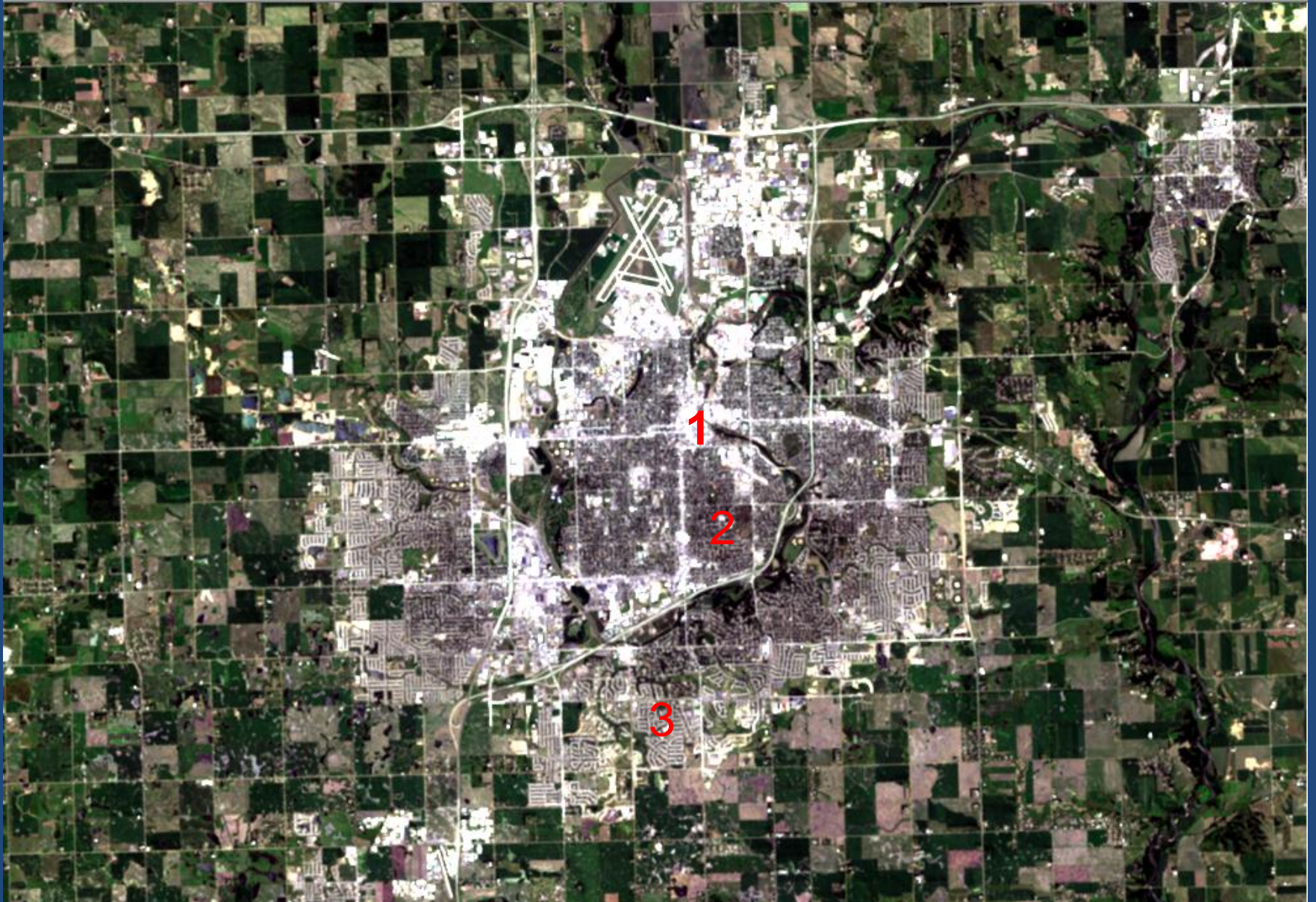
Bright =
Increased
Greenness



NDVI Trends; Pumice Desert, Crater Lake, Oregon



Sioux Falls Landsat 8 Data using Red, Green and Blue Bands (True Color); July 12, 2013

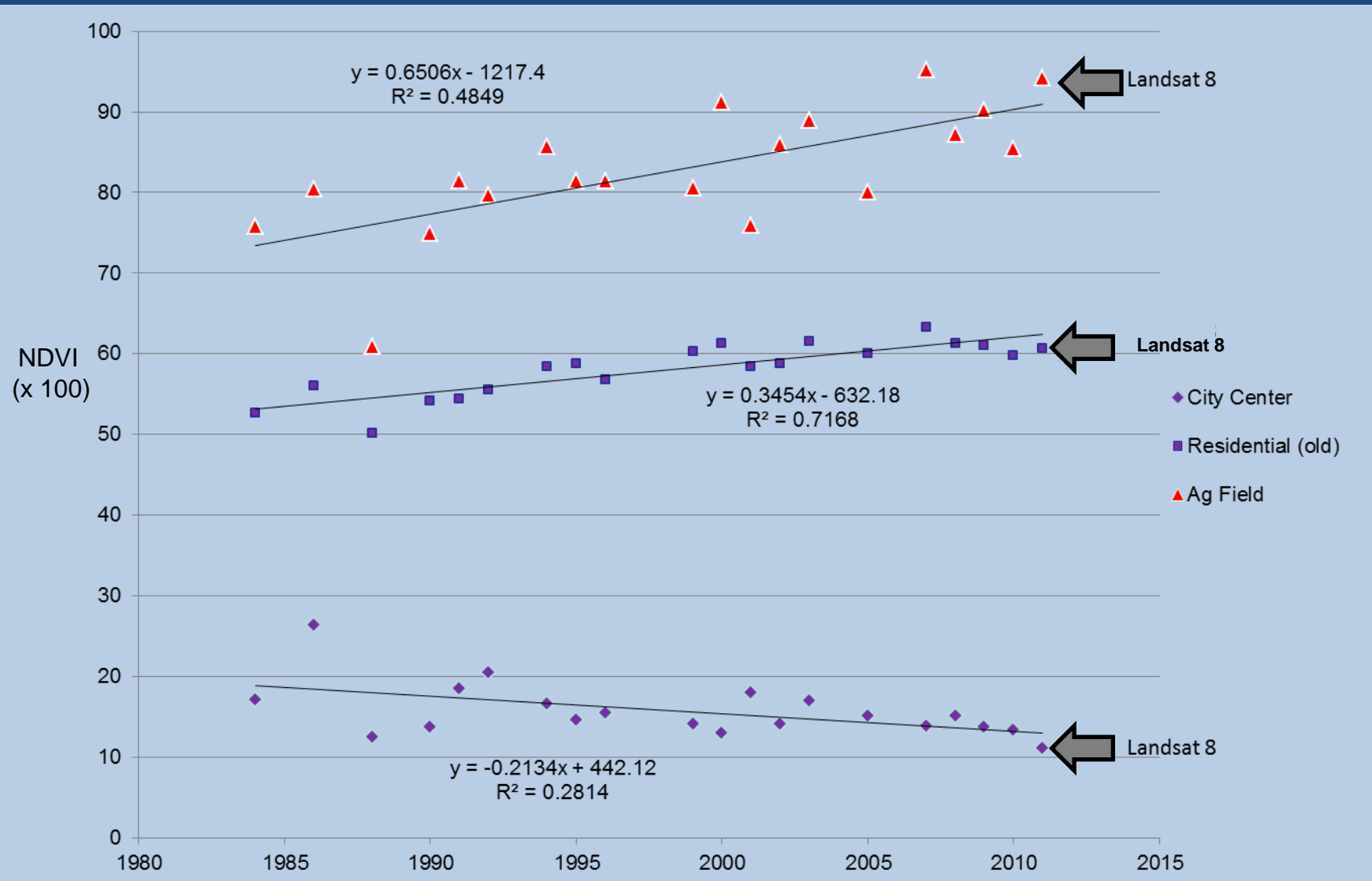


1 City Center

2 Old Residential

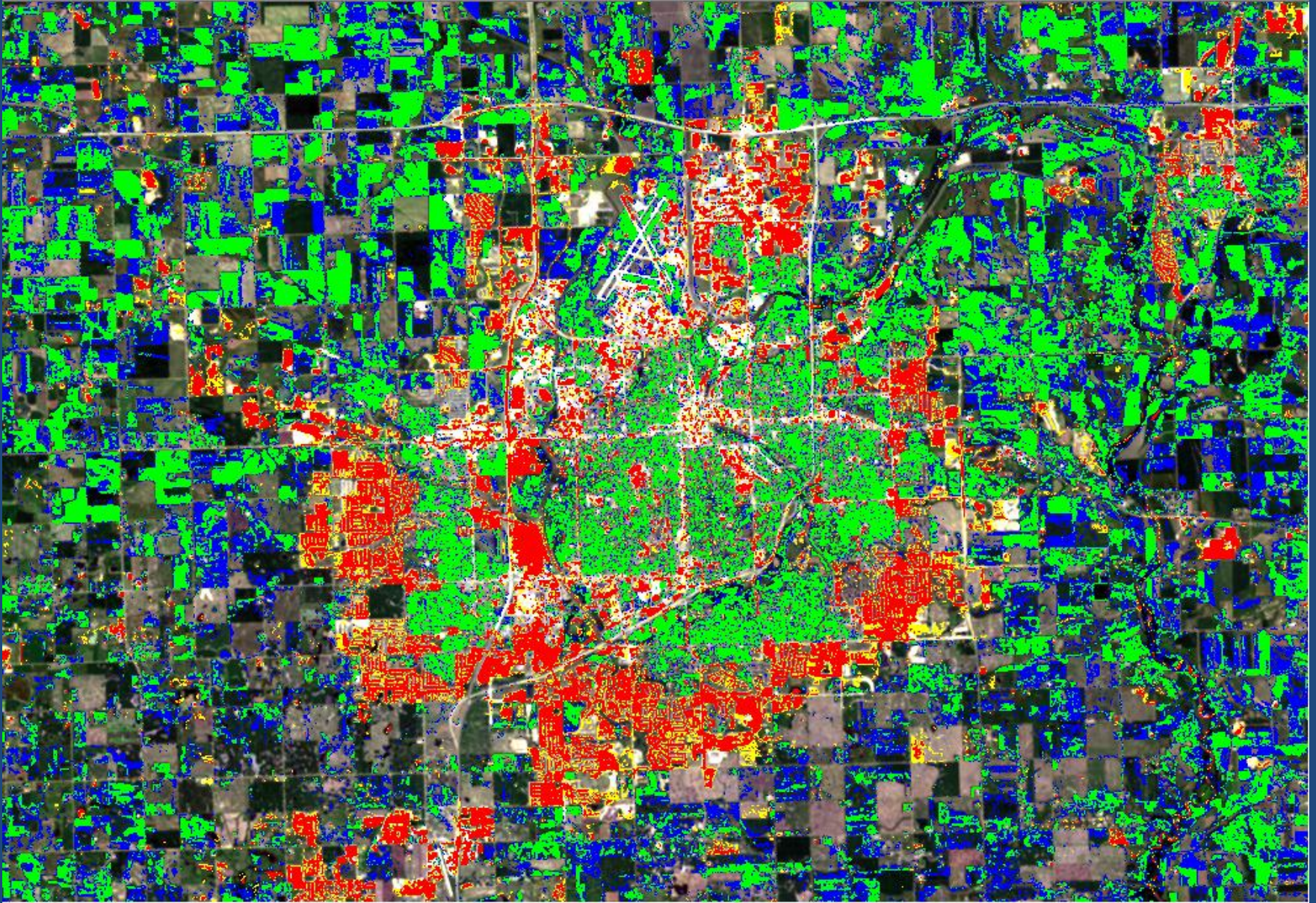
3 New Residential

Trends in NDVI (Greenness) from 1984 through 2013 using Landsat in Sioux Falls SD



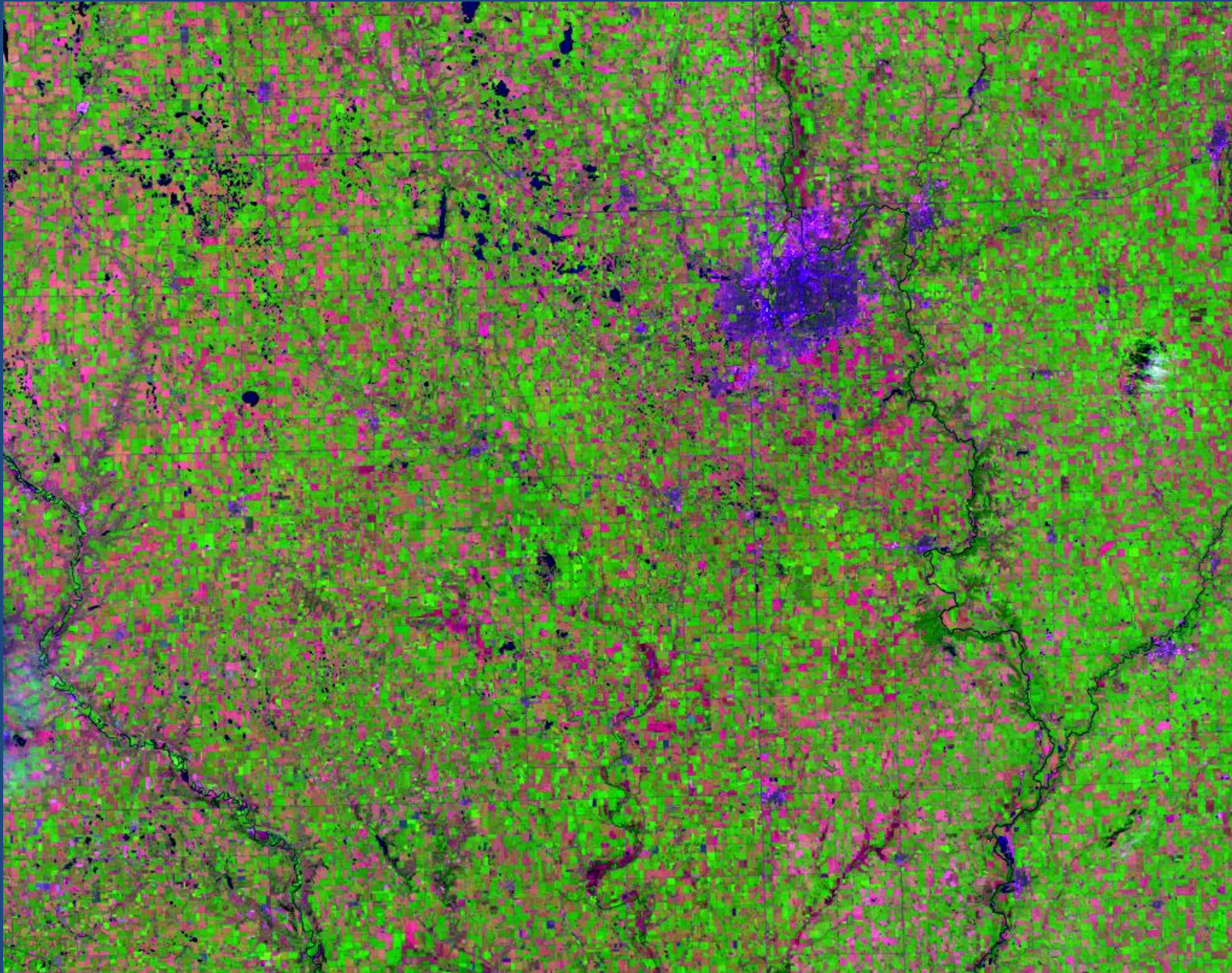
Landsat 8 enables the continuity of Landsat “moderate scale” trend observations

NDVI Trends in Sioux Falls Environs (1984 through 2013)



Red and Yellow = Decreased NDVI trends (in recent residential areas); Green and Blue = Increased NDVI trends (in ag and older residential areas)

Sioux Falls and Surrounding Agricultural Lands



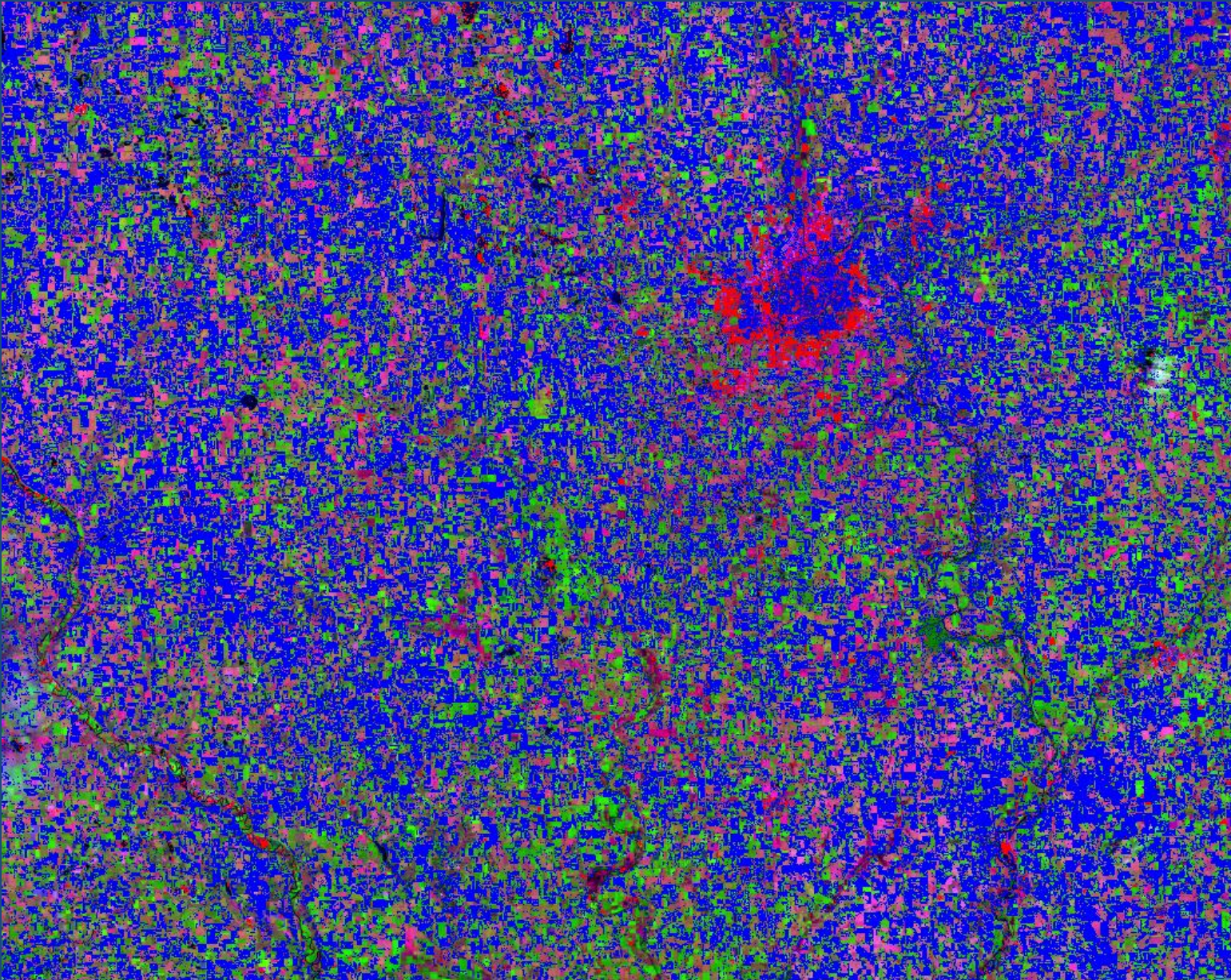
1984-2013 NDVI Trends; Sioux Falls and Surrounding Agricultural Lands

Red =
Decrease
In NDVI

Blue =
Increase
In NDVI

Take Home:

Despite
the high
variability
in ag lands,
increased
NDVI
trends are
apparent



Some General Observations

- Gradual change is pervasive. It's everywhere!
- We don't always know what the changes represent, but we can generally figure it out with additional information.
- Gradual change is often pronounced in ecological transition zones.
- We are beginning to see relationships between image and climate trends.

Part 2: Image is Everything

Some General Background

- Early in career, Dr. Harold Lang (geologist then at JPL) gave some remote sensing advice to me: “Look at the imagery first; then do the analyses”
- Many times, features that I have expected to see in images have not been observable
 - In many cases, suspected due to lack of radiometric resolution
 - In other cases, suspected due to atmospheric haze
- With 12 bit data of Landsat 8, what “new” features can we see?
 - 4096 versus 256 grey levels per band
 - Focused on areas of (presumed) spectral homogeneity
 - Water
 - “Homogeneous” vegetation
 - Concentrated on visible bands for vegetated communities areas; Dynamic range in visible has always been minimal in vegetated areas
- When possible, used underfly data for comparisons

Lake Pontchartrain, LA; Landsat 8 Red, Green and Blue Bands
Underfly data



Lake Pontchartrain, LA; Landsat 7 Red, Green and Blue Bands



Box denotes area used for next several slides

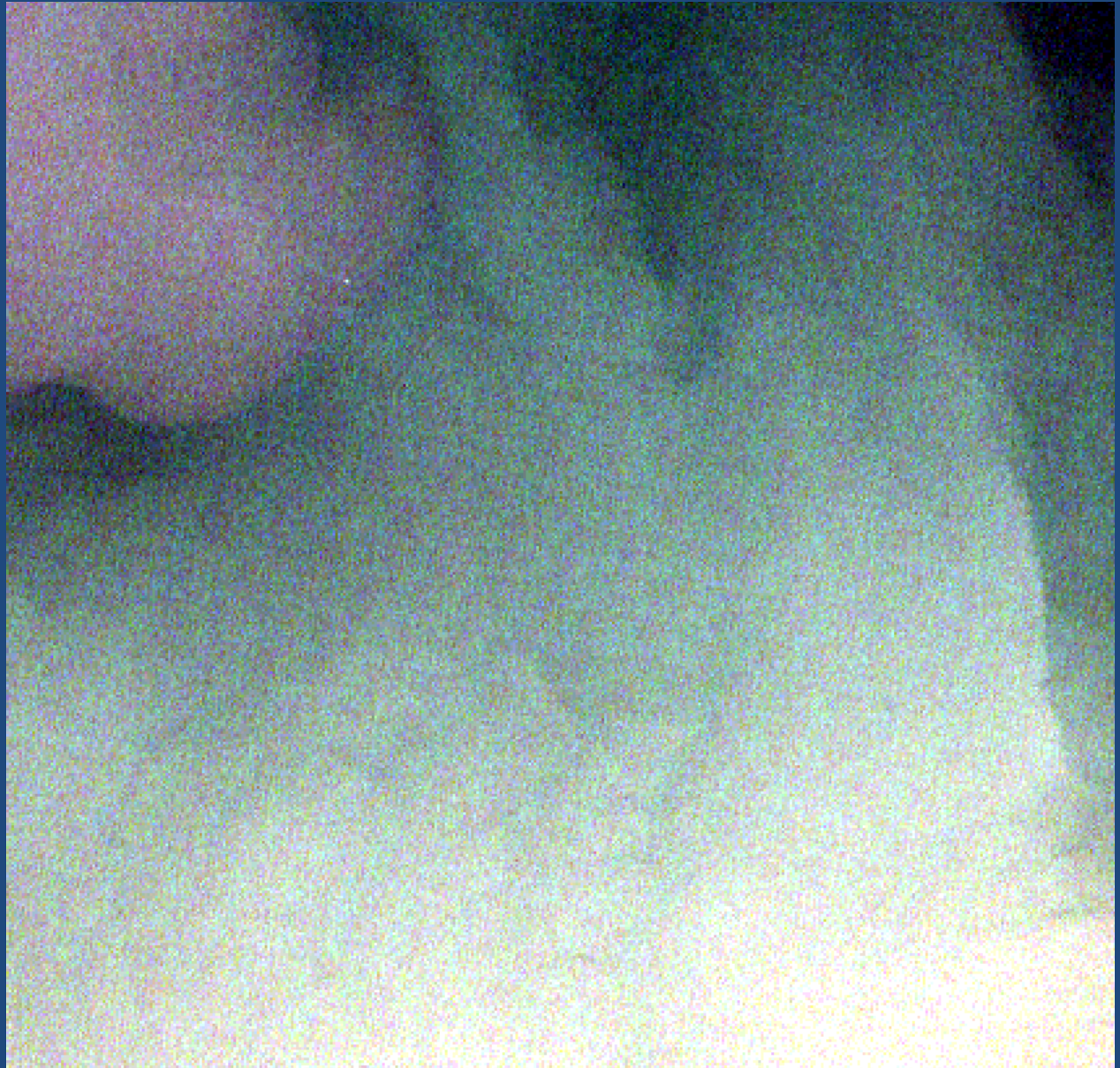


Mean DN Statistics from Lake Pontchartrain

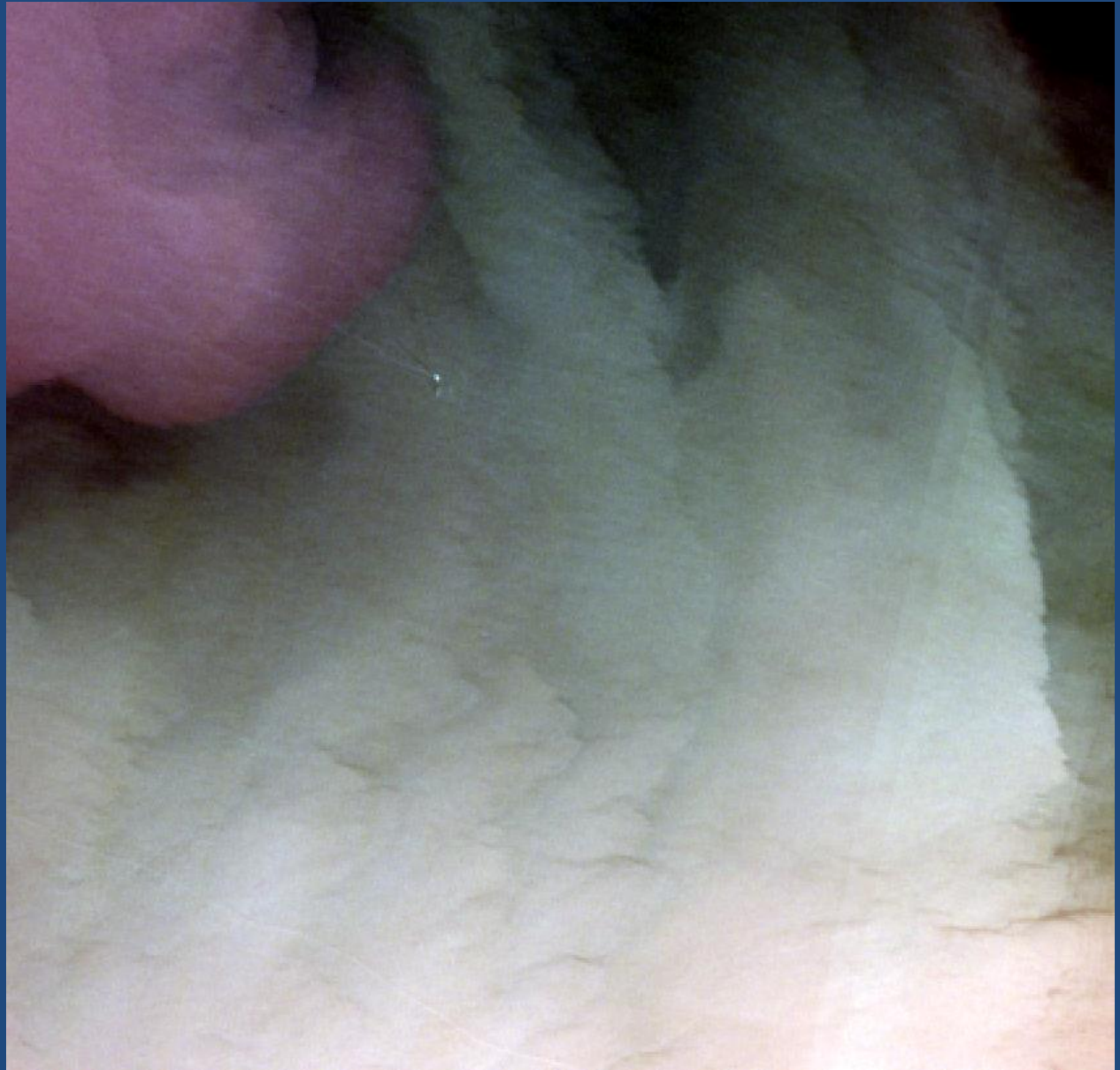
Band	Landsat 7*	Landsat 8
Blue	56.6 (1.5)	9680 (97.8)
Green	45.9 (2.0)	9213.6 (168.7)
Red	43.6 (3.6)	8801.9 (316.3)
NIR	16.3 (1.16)	6325.1 (88.8)
SWIR 1	13.4 (0.9)	5507.1 (58.9)
SWIR 2	12.3 (1.1)	5378.8 (49.6)
Pan	30.9 (2.4)	9011.6 (217.6)

	L7 water ranges	L8 water ranges
Blue band:	13 DN	over 500
Green band:	14 DN	over 900
Red band:	22 DN	over 150
NIR band:	8 DN	over 450
SWIR 1:	10 DN	over 400
SWIR 2:	11 DN	over 375

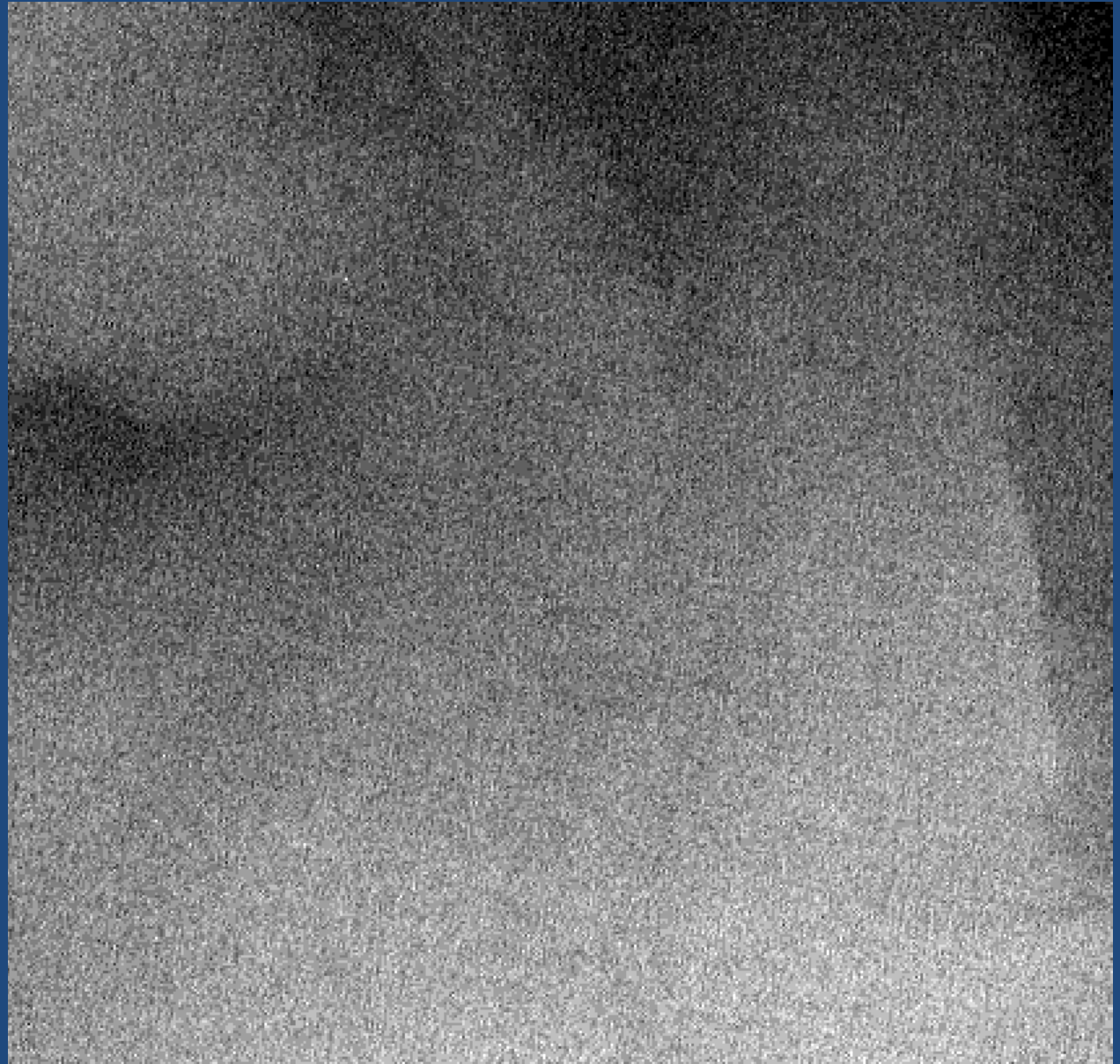
Landsat 7;
Red, Green and
Blue bands



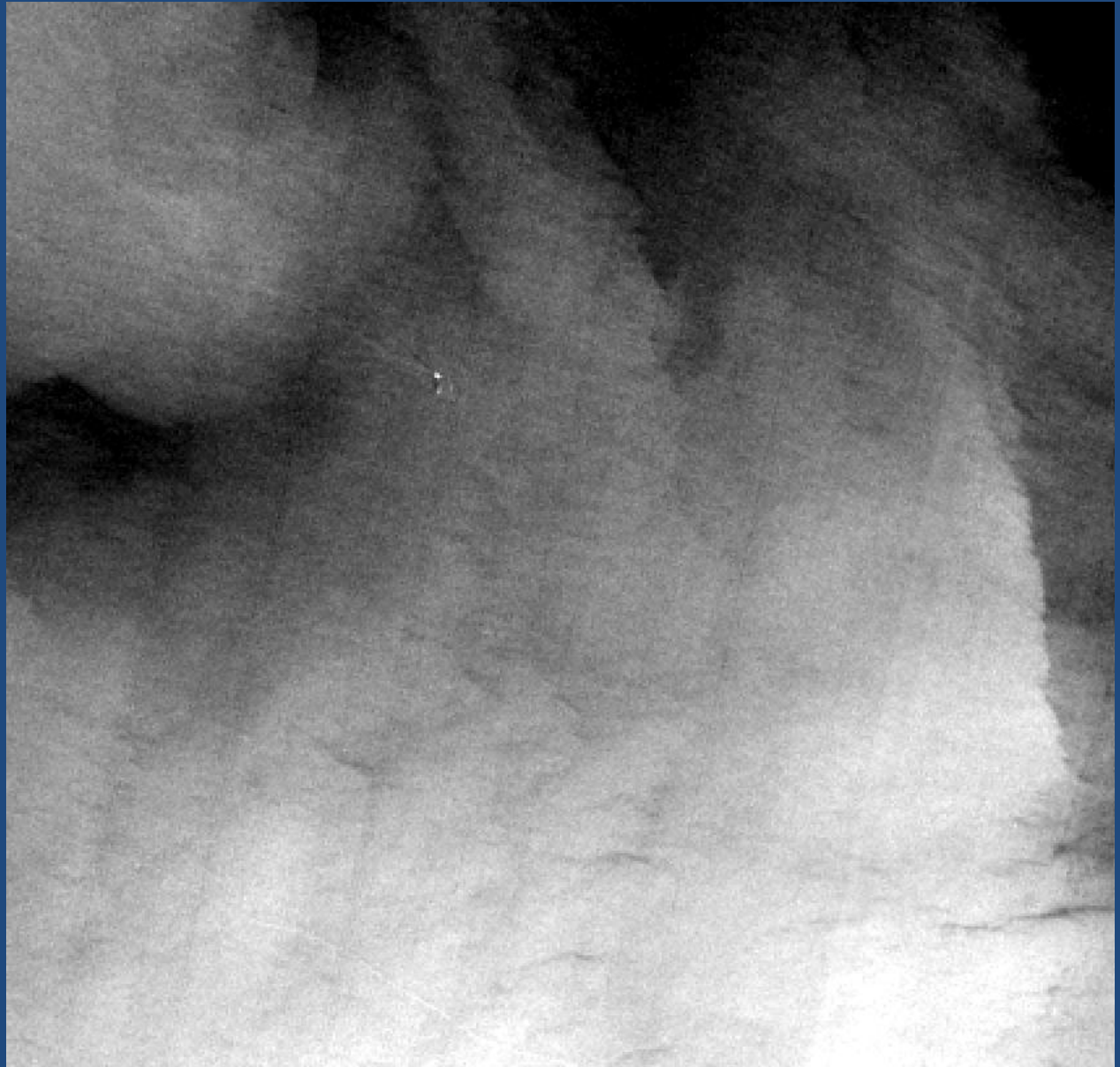
Landsat 8;
Red, Green and
Blue bands



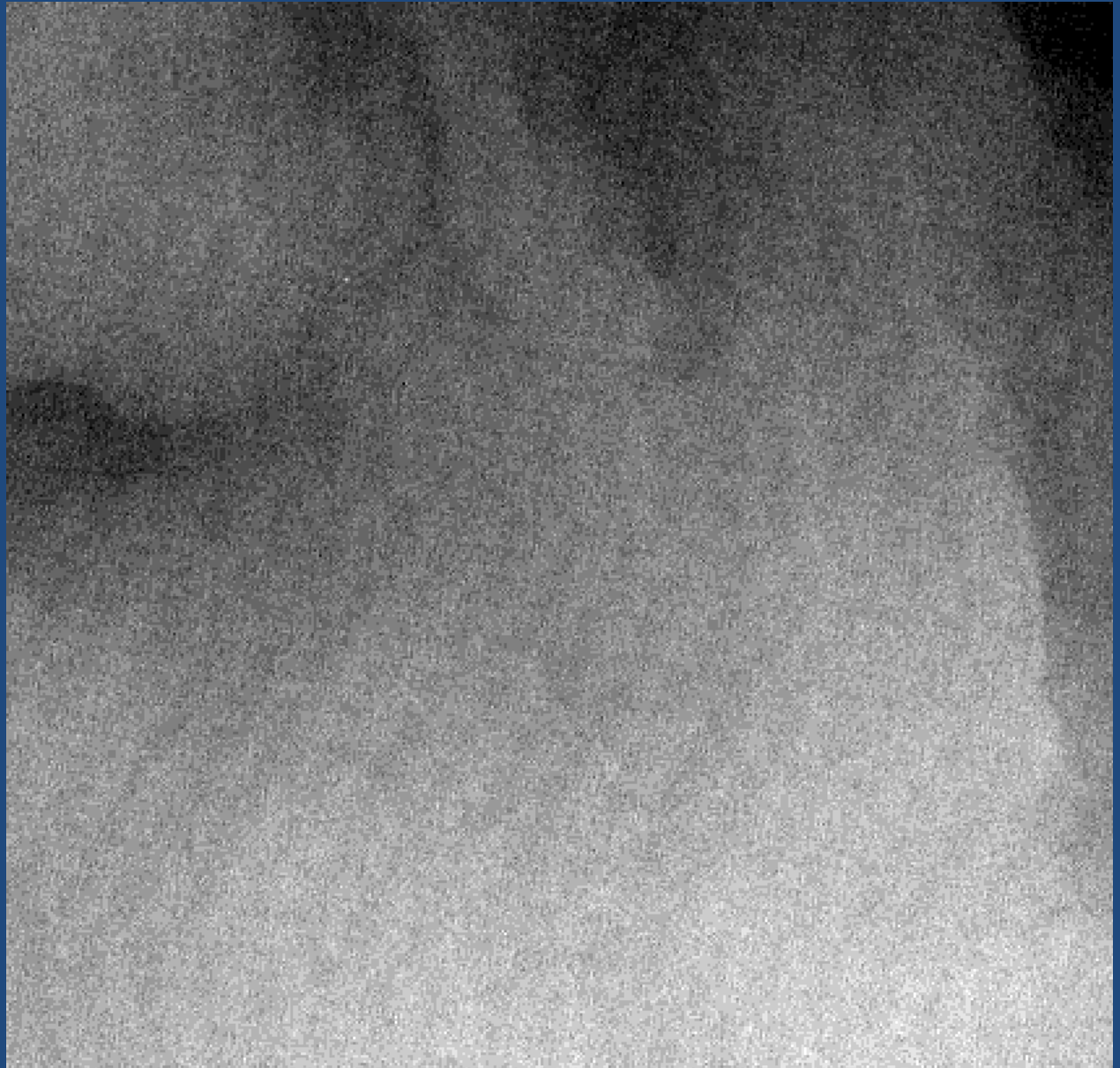
Landsat 7;
Blue Band



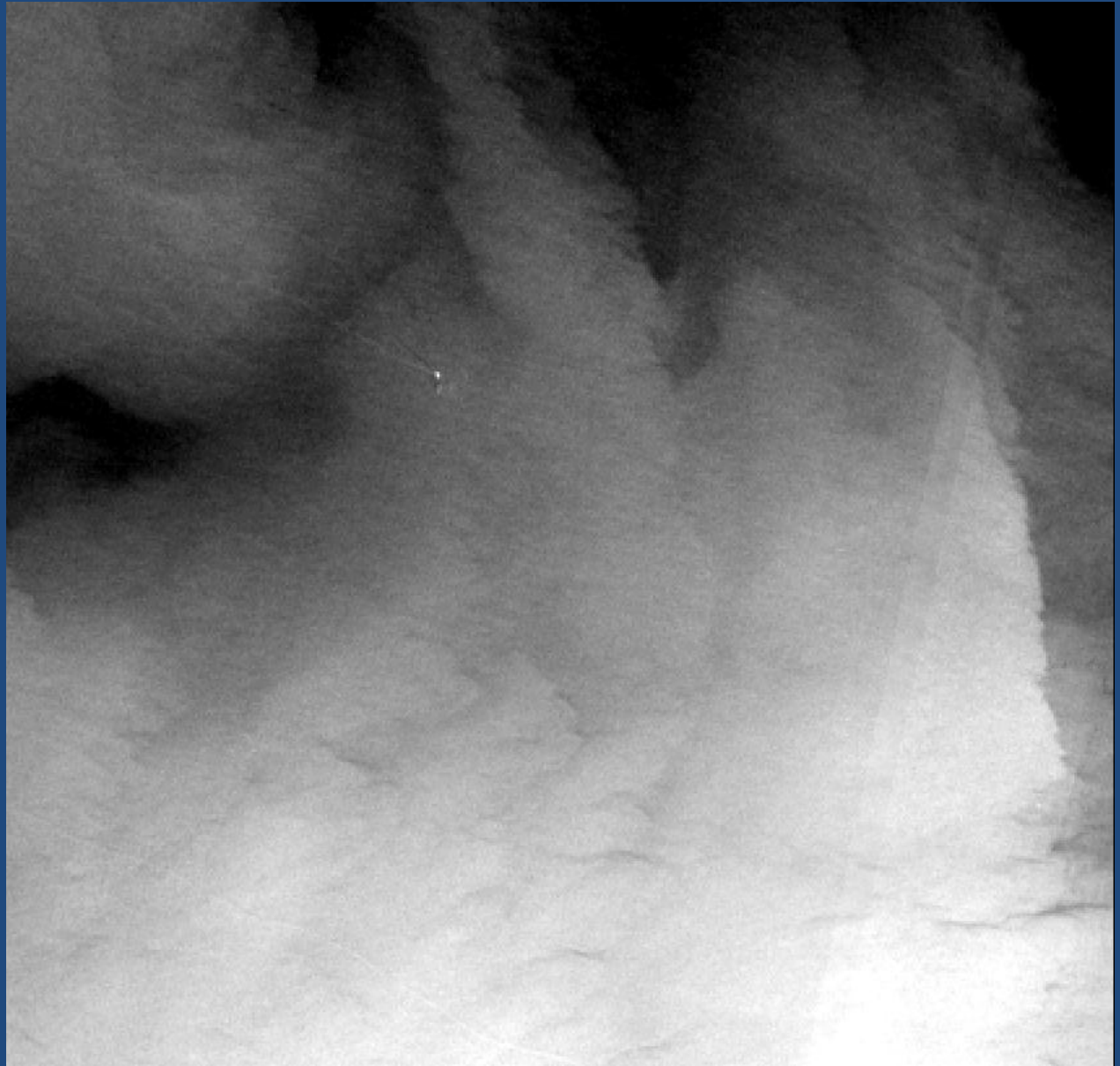
Landsat 8;
Blue Band



Landsat 7;
Green Band



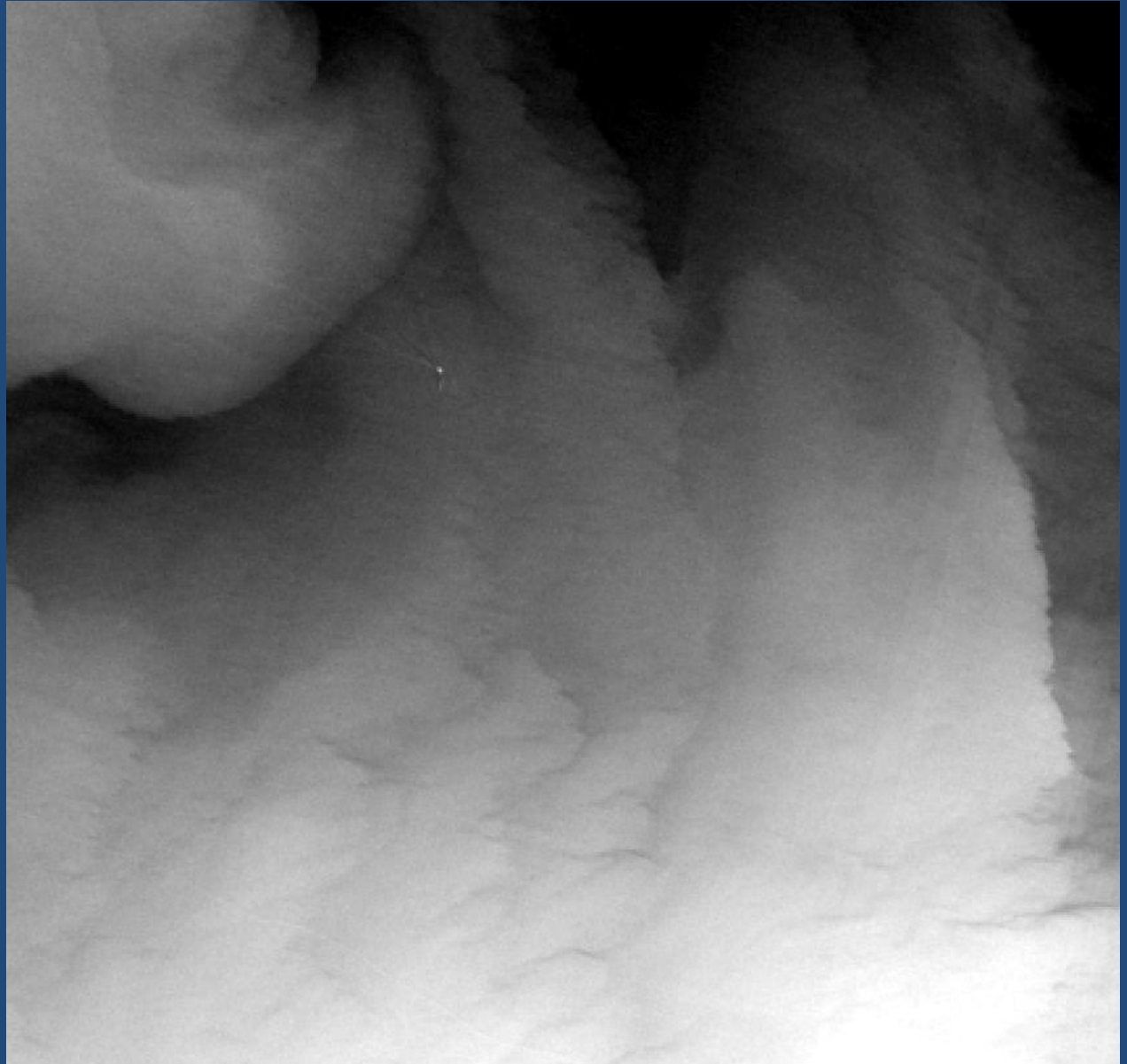
Landsat 8;
Green Band



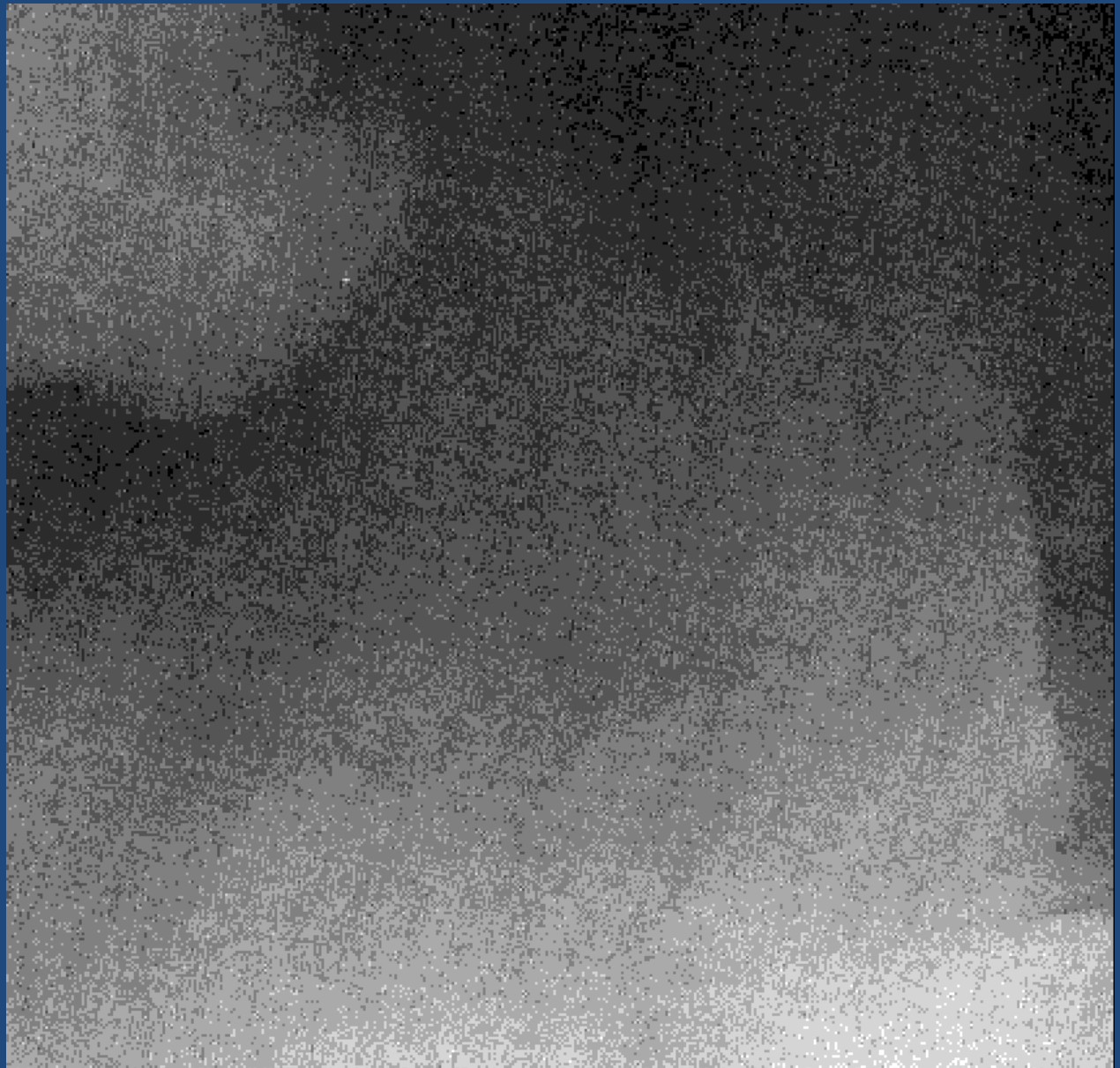
Landsat 7;
Red Band



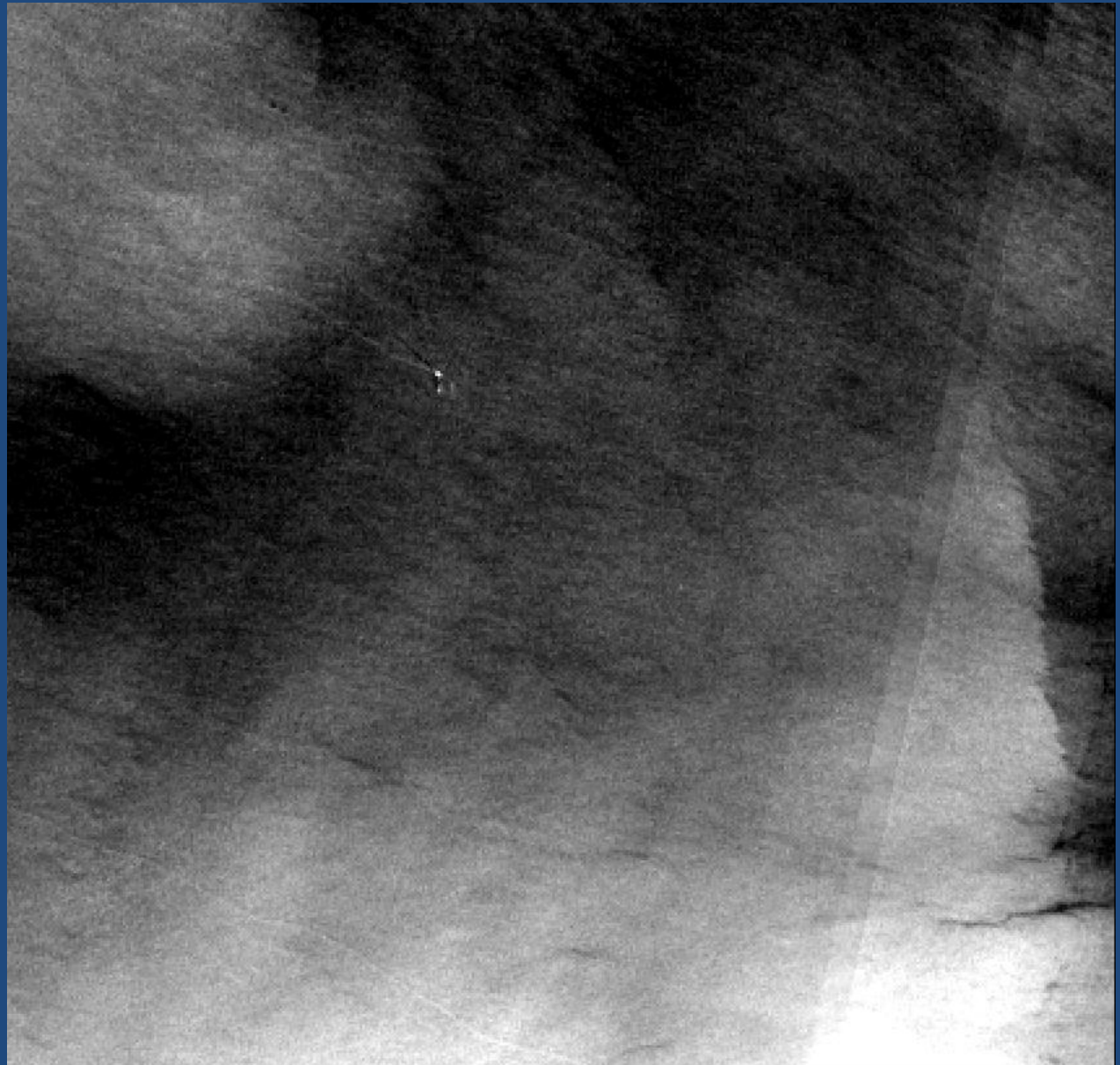
Landsat 8;
Red Band



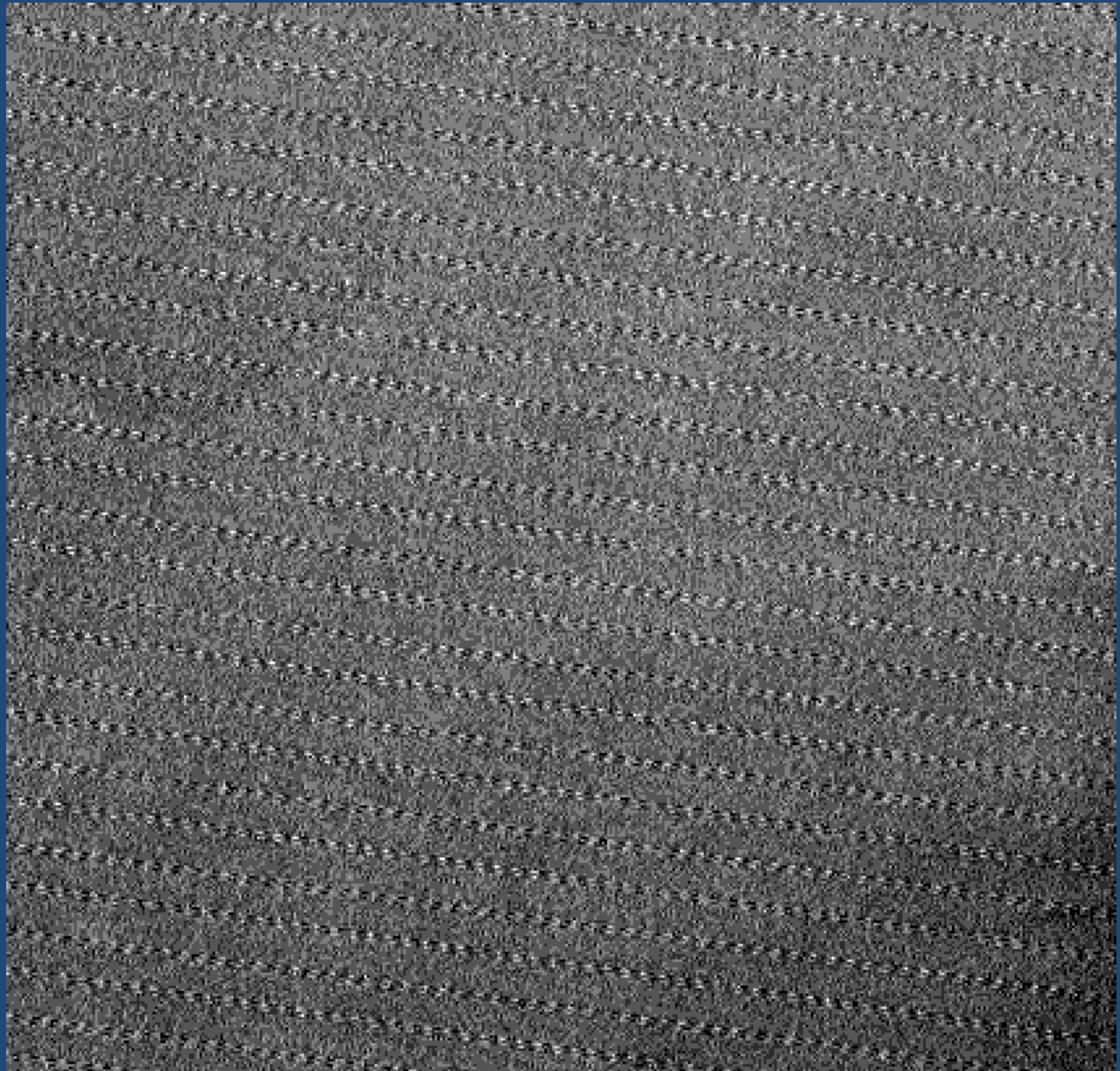
Landsat 7;
NIR Band



Landsat 8;
NIR Band



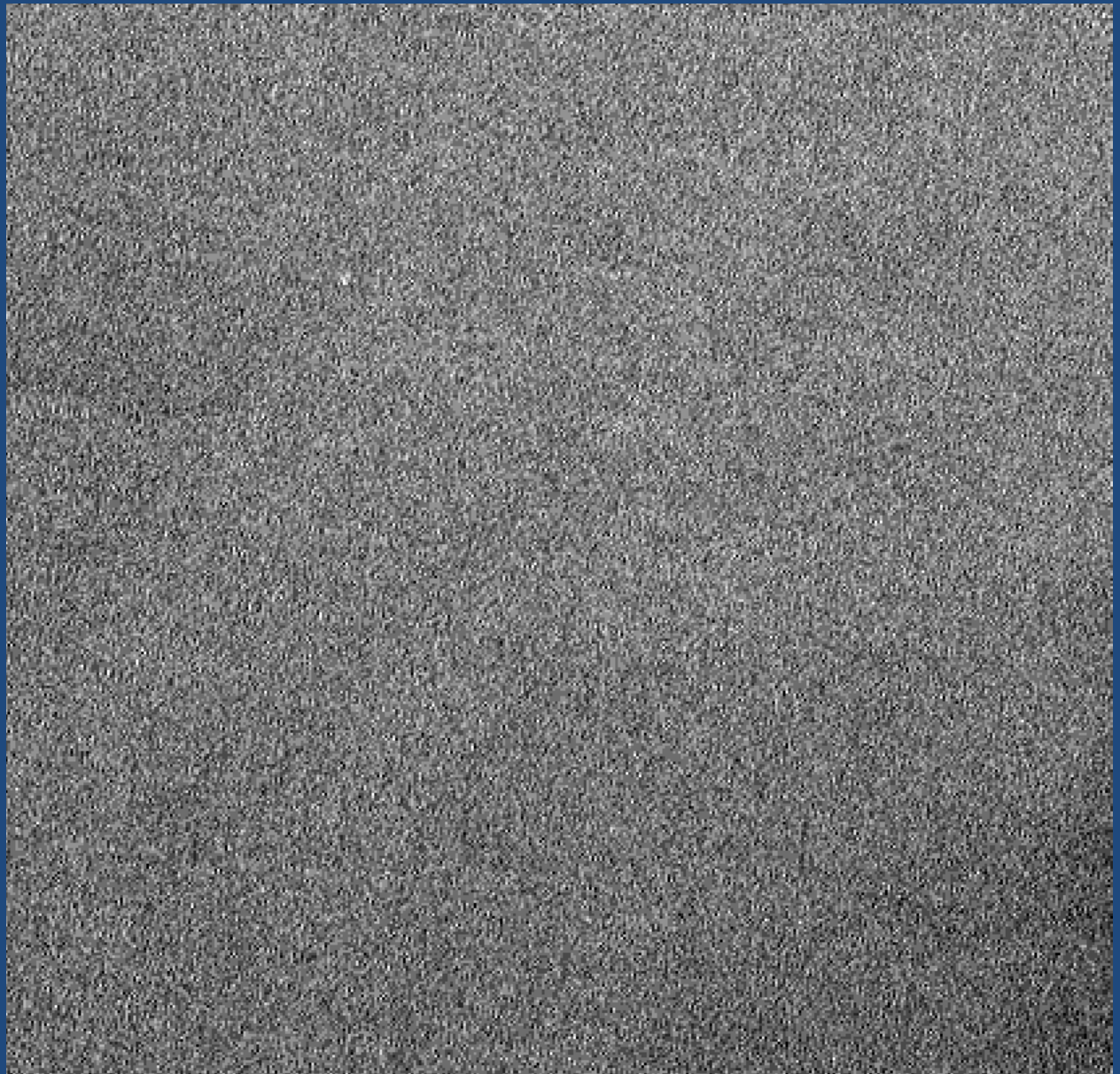
Landsat 7;
SWIR 1 Band



Landsat 8;
SWIR 1 Band



Landsat 7;
SWIR 2 Band



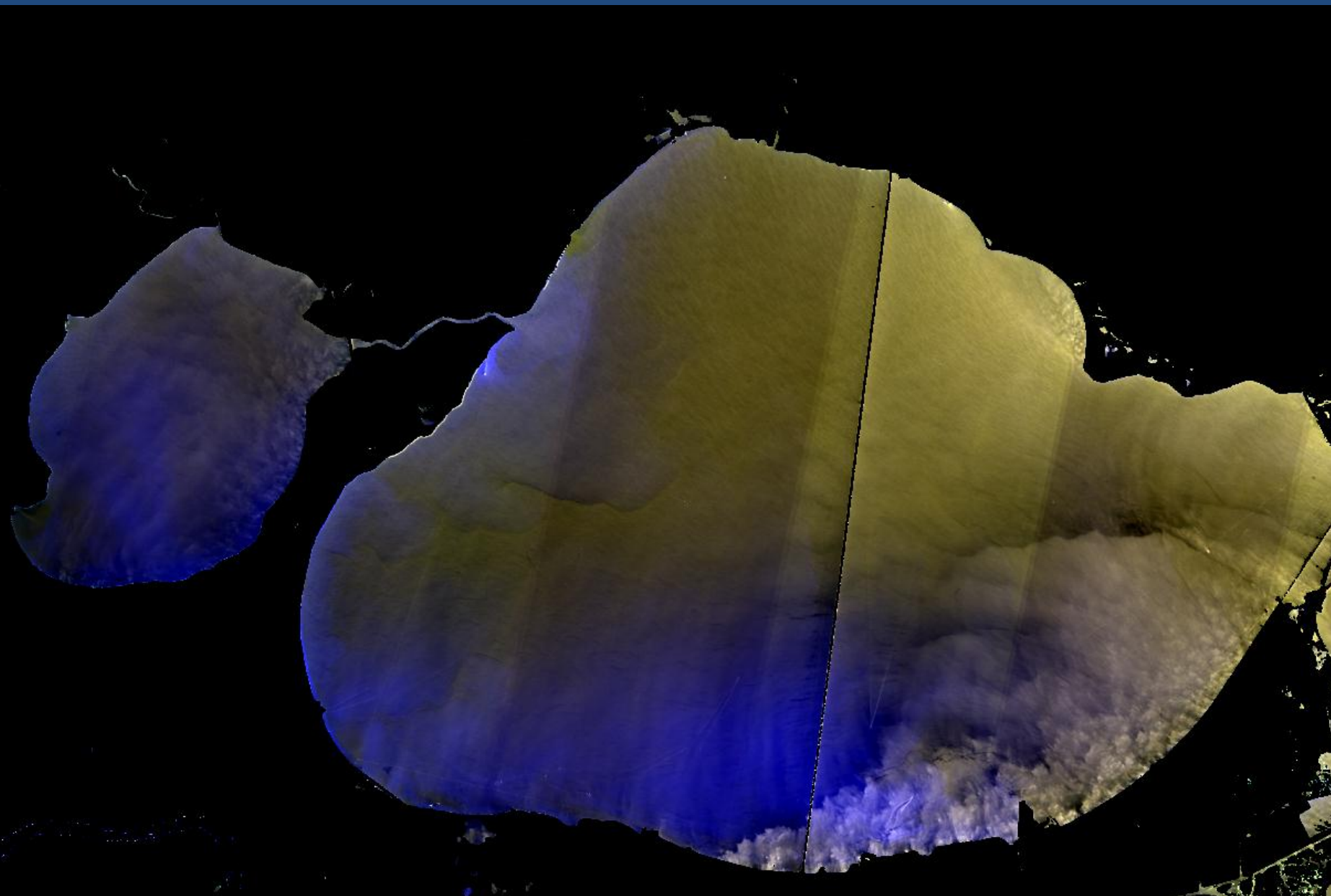
Landsat 8;
SWIR 2 Band



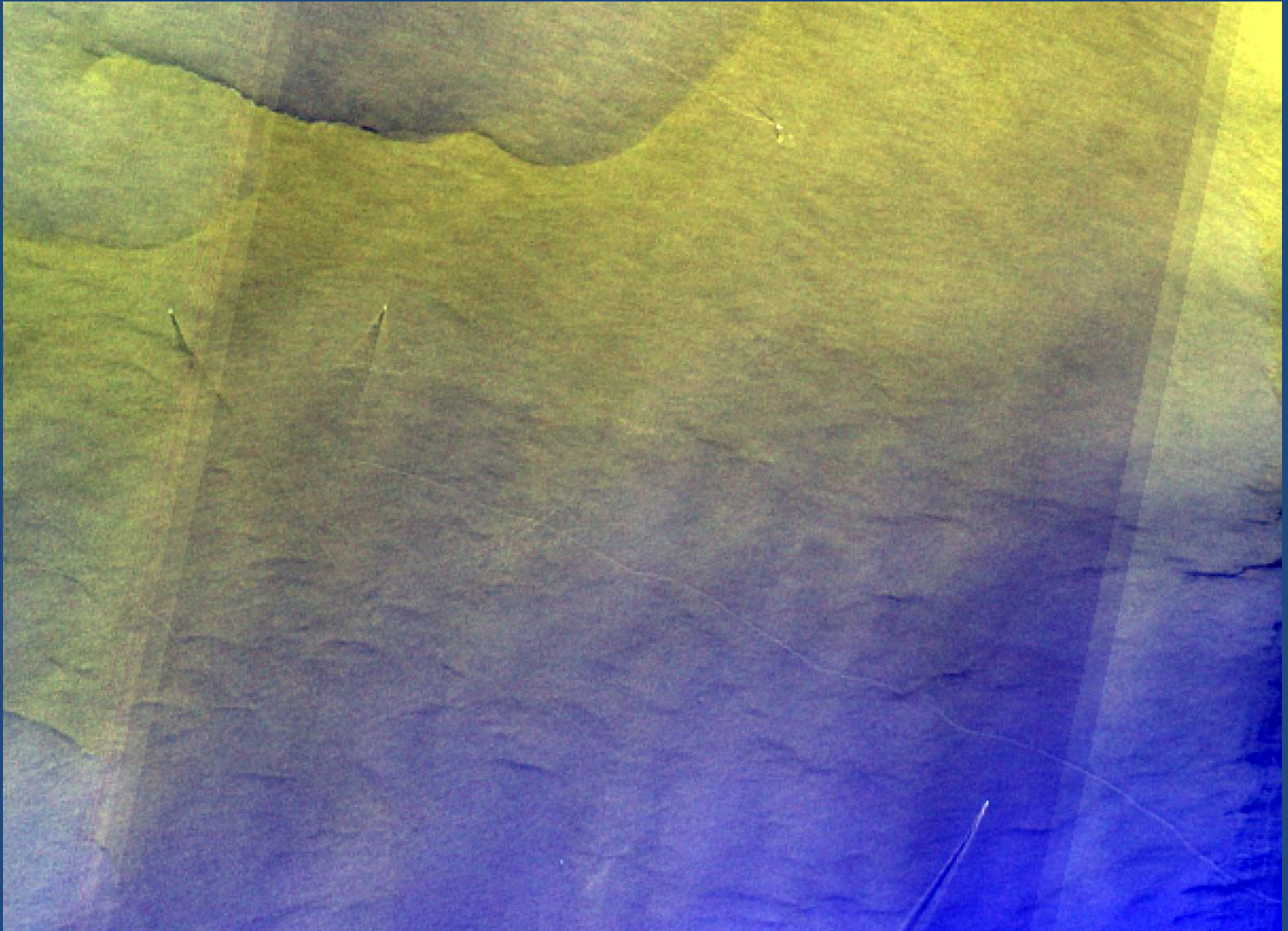
Lake Pontchartrain; Landsat 8; Red, Green and Blue Bands; Water Stretch



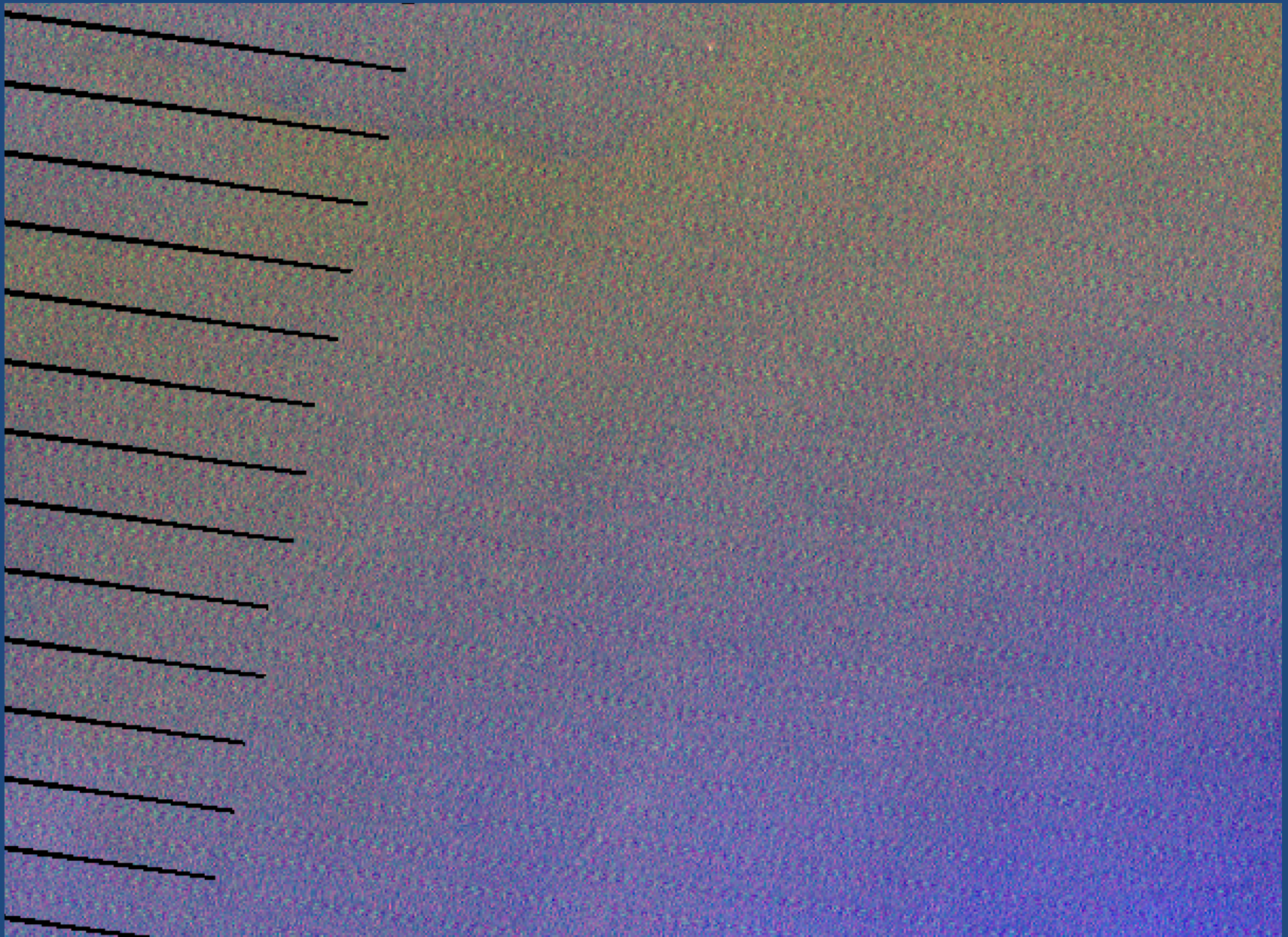
Lake Pontchartrain; Landsat 8; SWIR 2, SWIR 1 and NIR Bands; Water Stretch



L8; Boats! 😊



L7; No Boats! ☹️



Myanmar Forested Area

Landsat 8; SWIR 1, NIR, Red



Landsat 8; Red, Green, Blue



Landsat 7; Red, Green, Blue



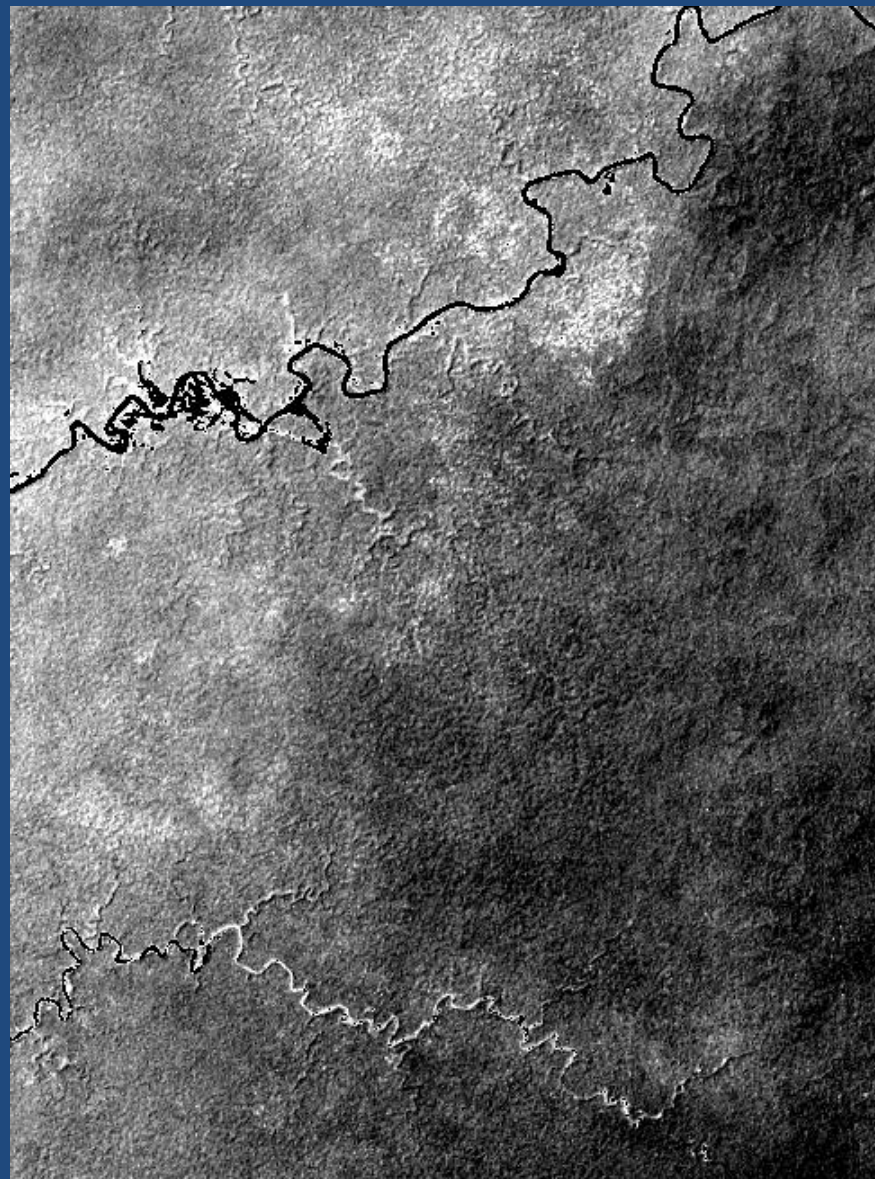
Landsat 8; Red, Green, Blue



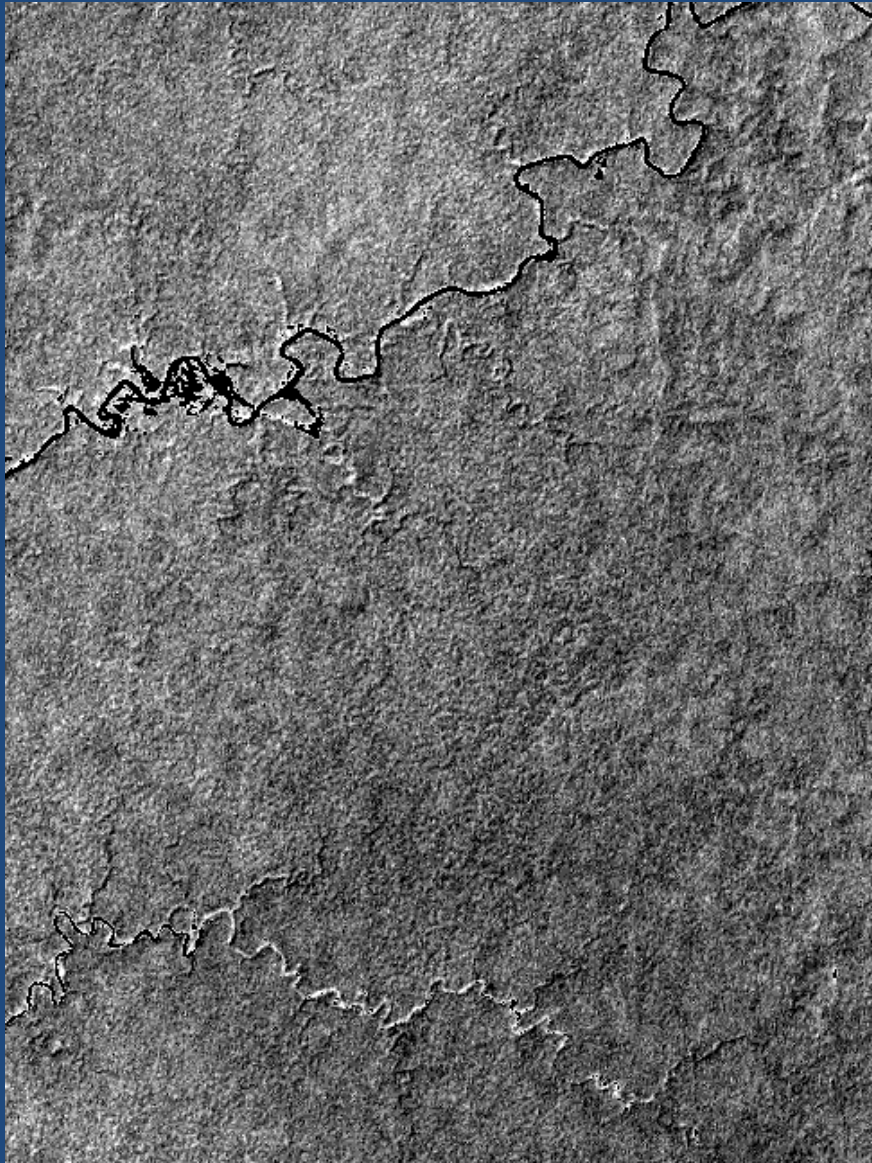
Landsat 7; Blue band



Landsat 8; Blue band



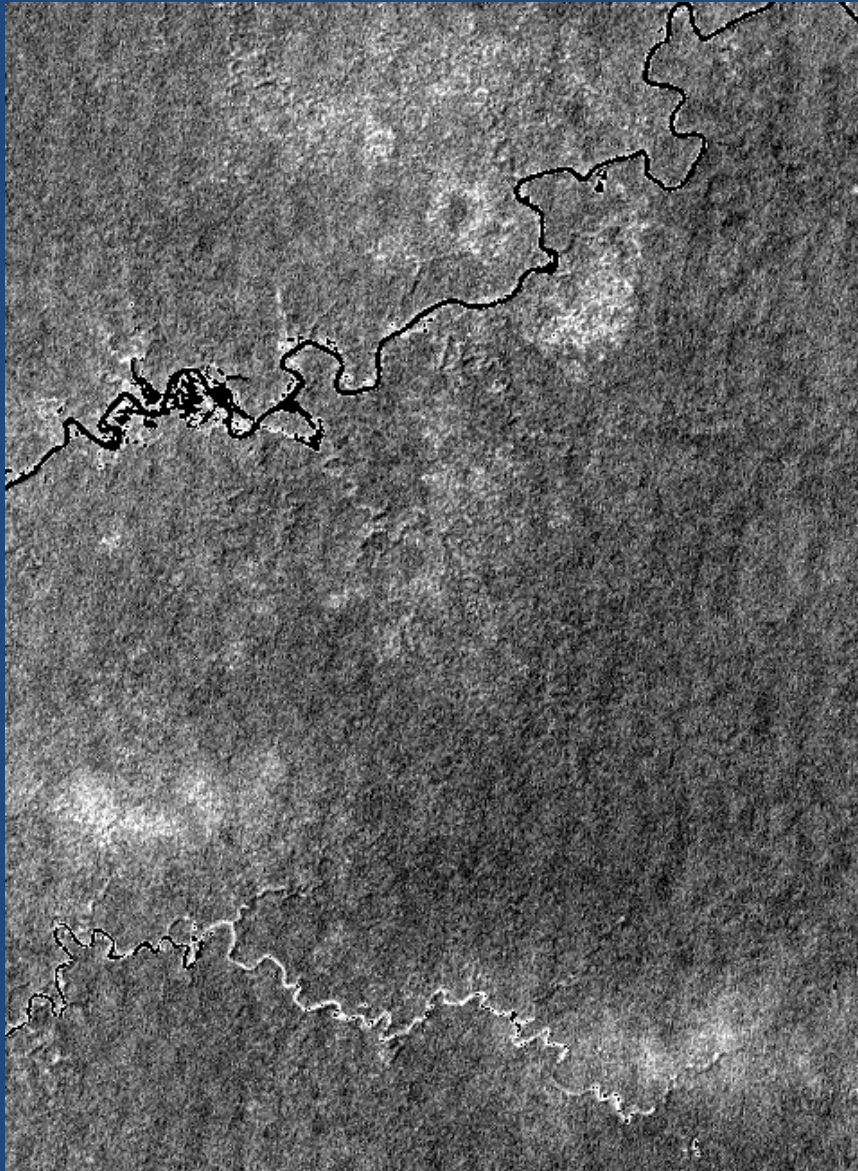
Landsat 7; Green band



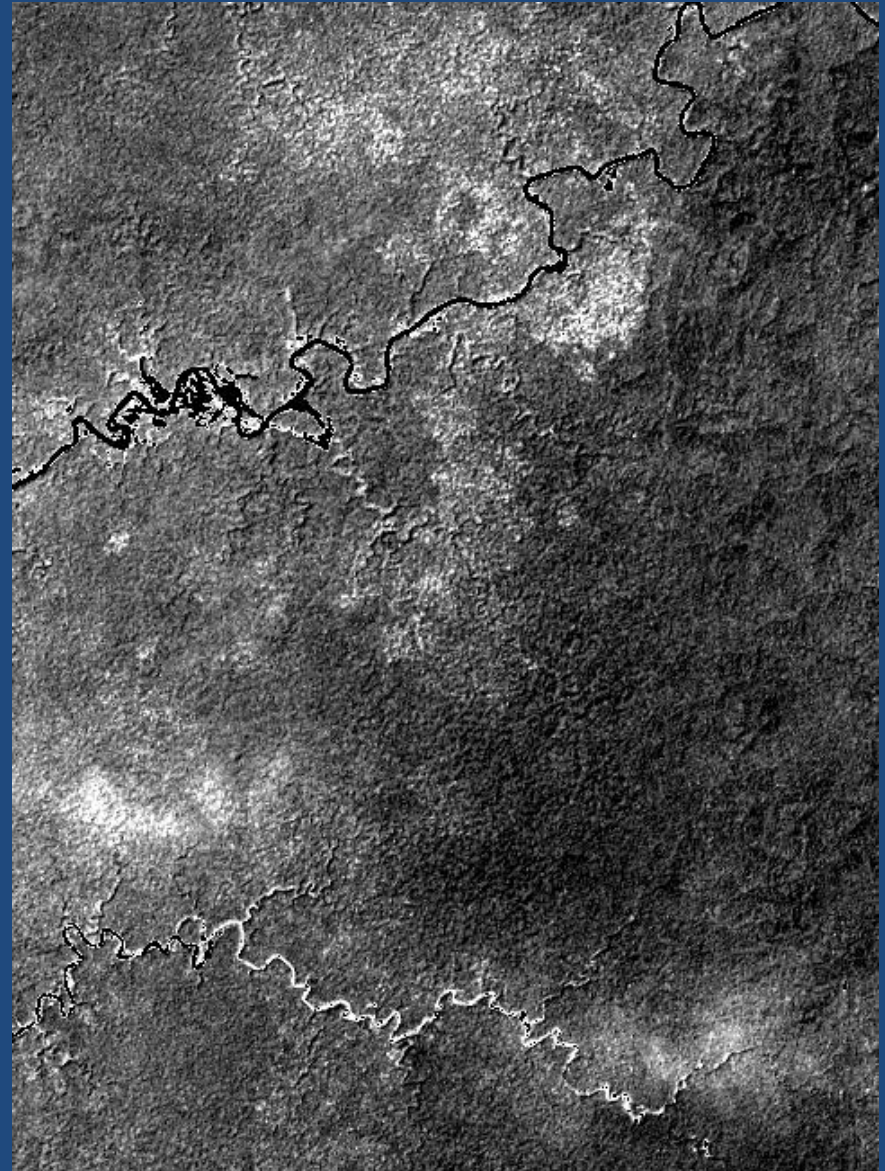
Landsat 8; Green band



Landsat 7; Red band

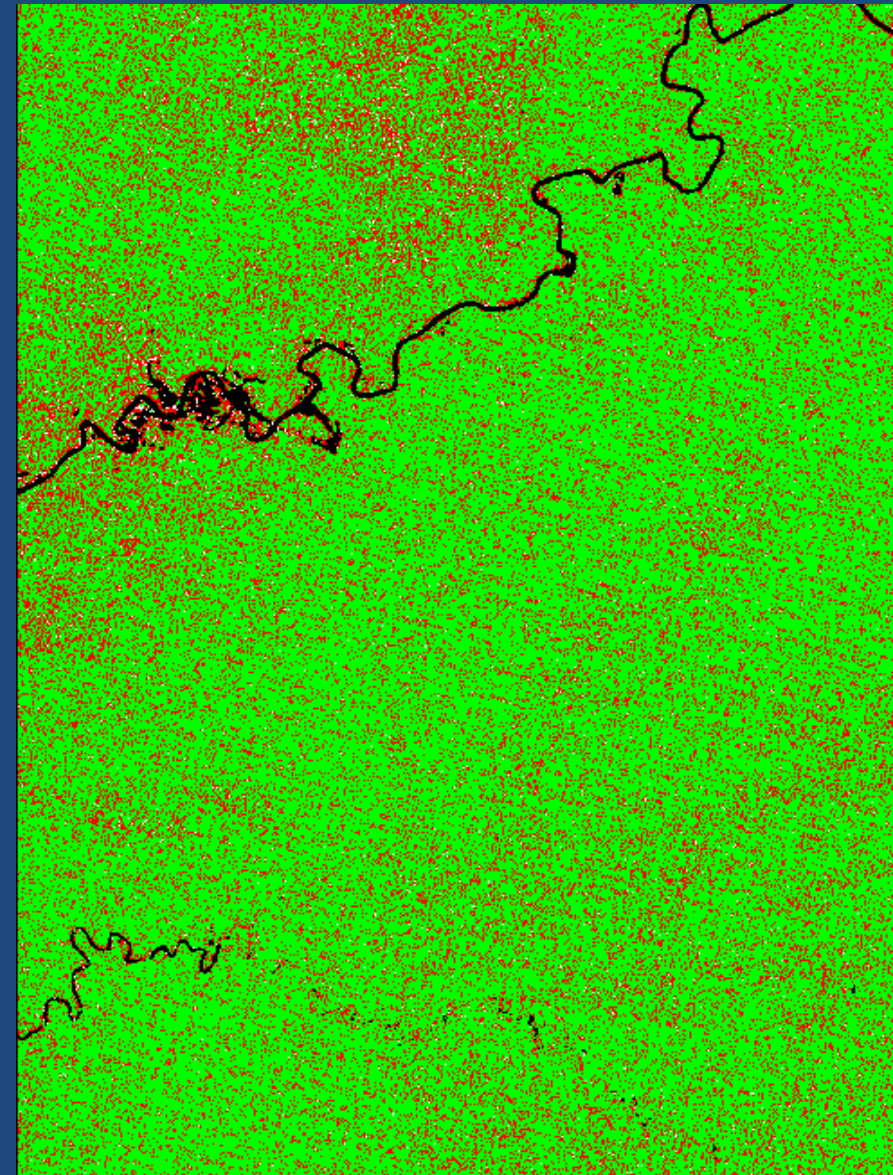


Landsat 8; Red band



Myanmar Green Vegetation DN Statistics

Band	Landsat 7	Landsat 8
Blue	76 (1.3)	9095 (47.4)
Green	55 (1.3)	8210 (91.2)
Red	43 (1.6)	7176 (89.7)
NIR	68 (4.5)	15259 (880)
SWIR 1	62 (4.4)	9991 (459)
SWIR 2	30 (2.3)	7007 (221)



L 7 Blue Band Pseudocolor Image

Green = Mean Plus or Minus 1 DN

Red = Plus or Minus 2 or 3 DN

Green and red represents a range of 7 DN, which is 99.4% of vegetated pixels in the image (330 DN is comparable range for L8 blue band)

Brazil Forested Area; Data acquisition offset by 8 days

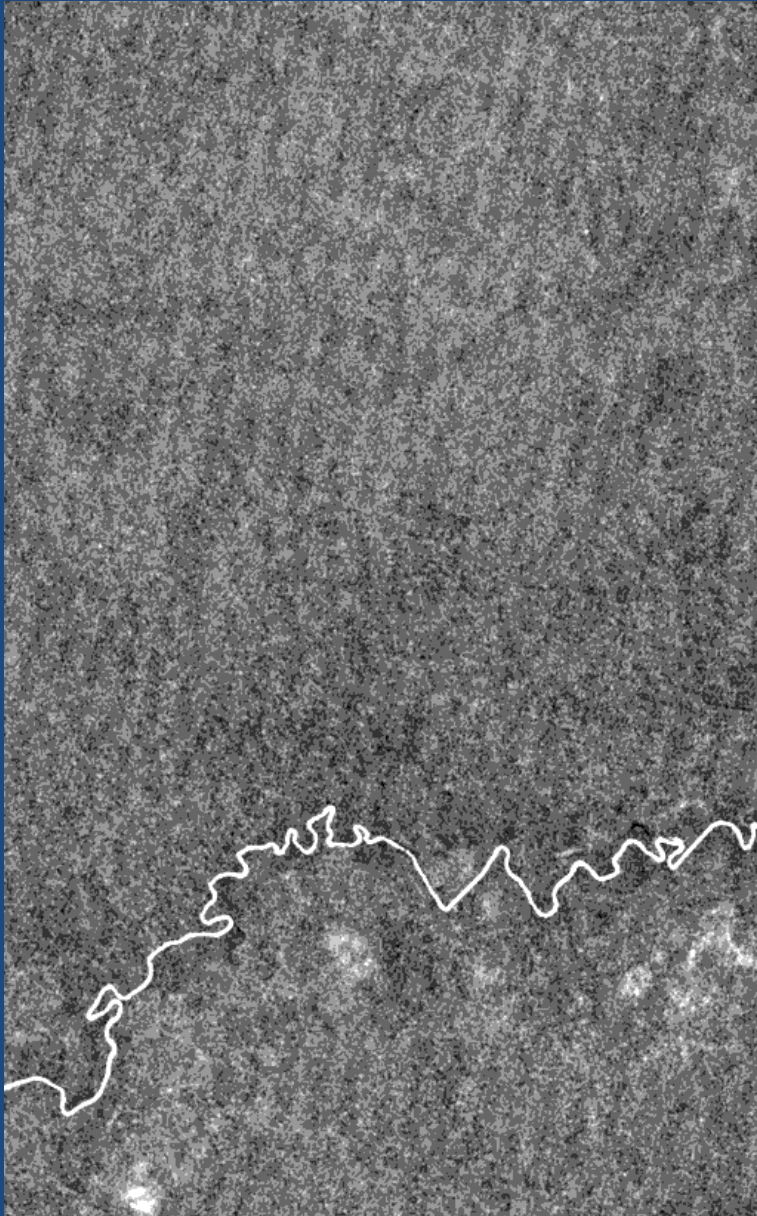
Landsat 8; Red, Green, Blue



Landsat 8; Red, Green, Blue



Landsat 7; Red band



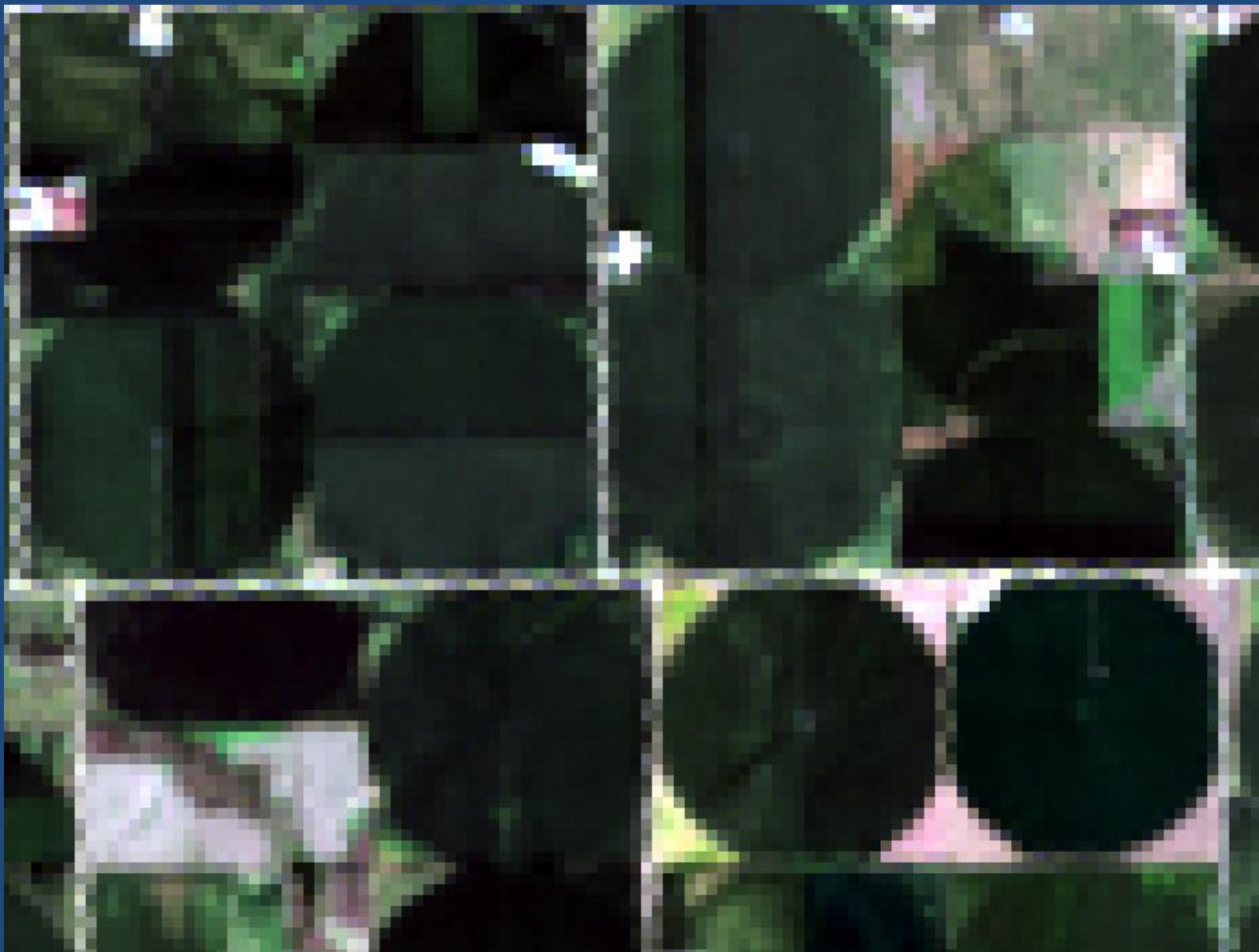
Landsat 8; Red band



Landsat 7; Irrigated Ag; Nebraska; Red, Green and Blue Bands

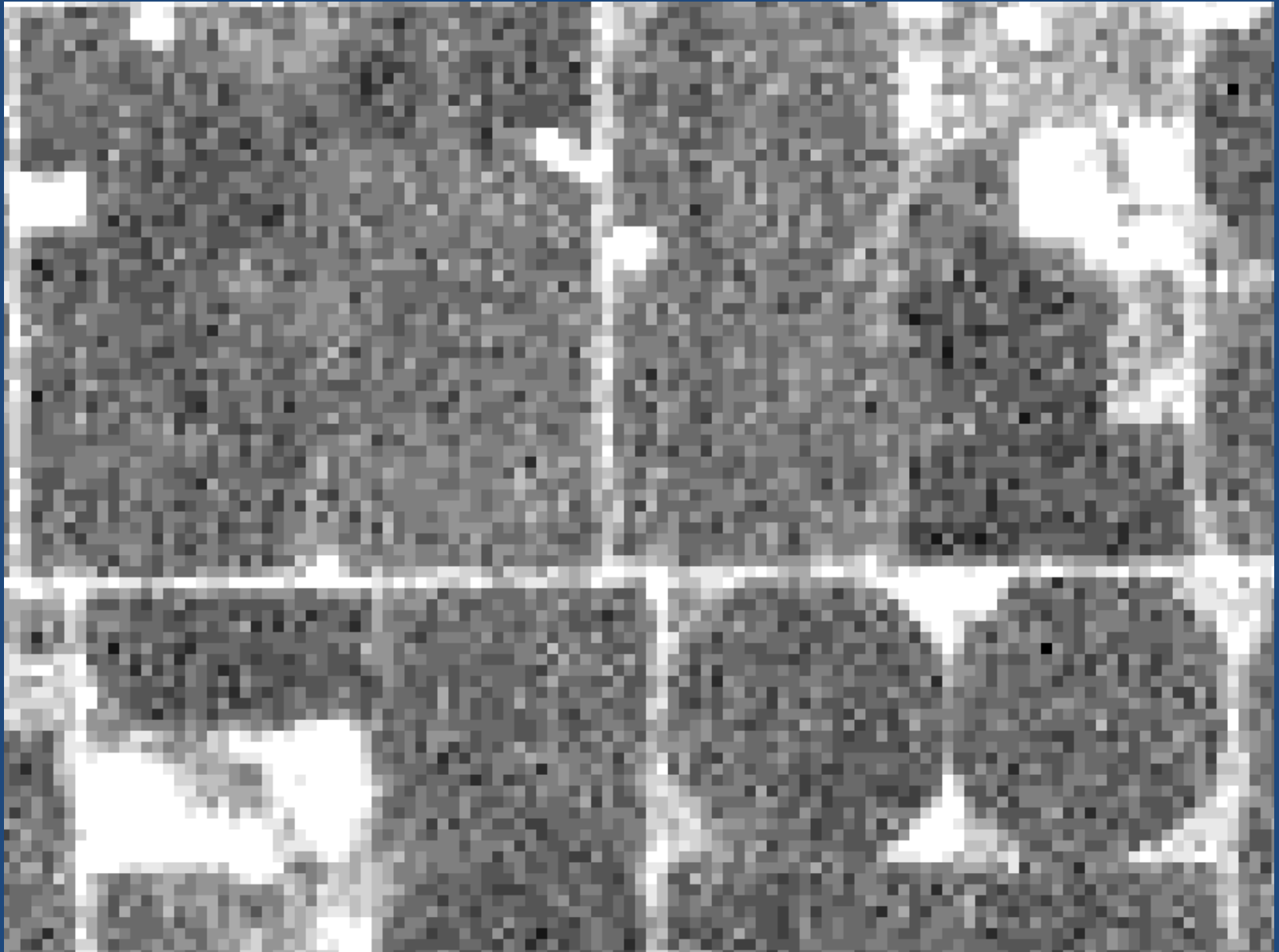


Landsat 8; Irrigated Ag; Nebraska; Red, Green and Blue Bands

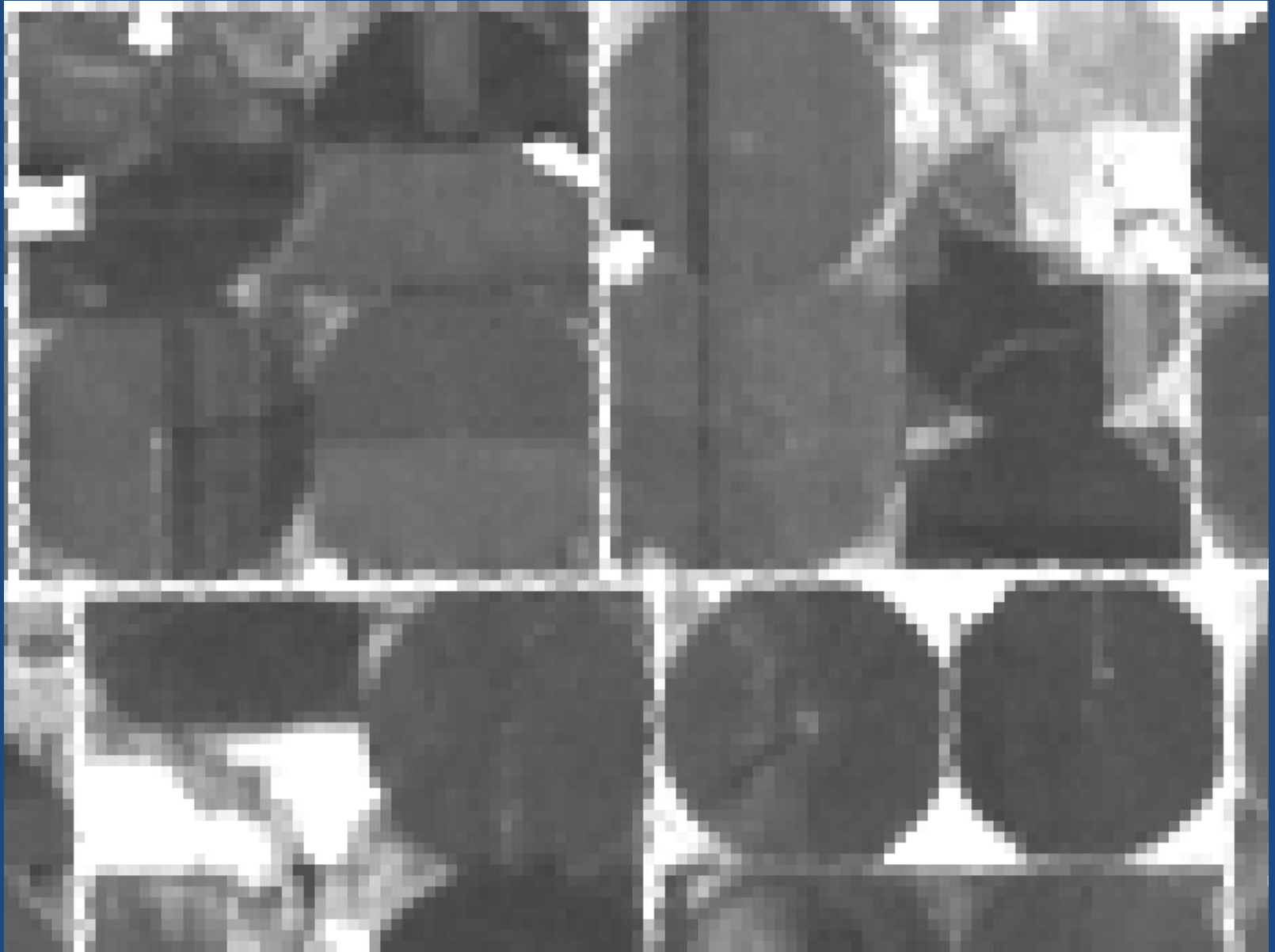


*Data acquisitions offset by 8 days

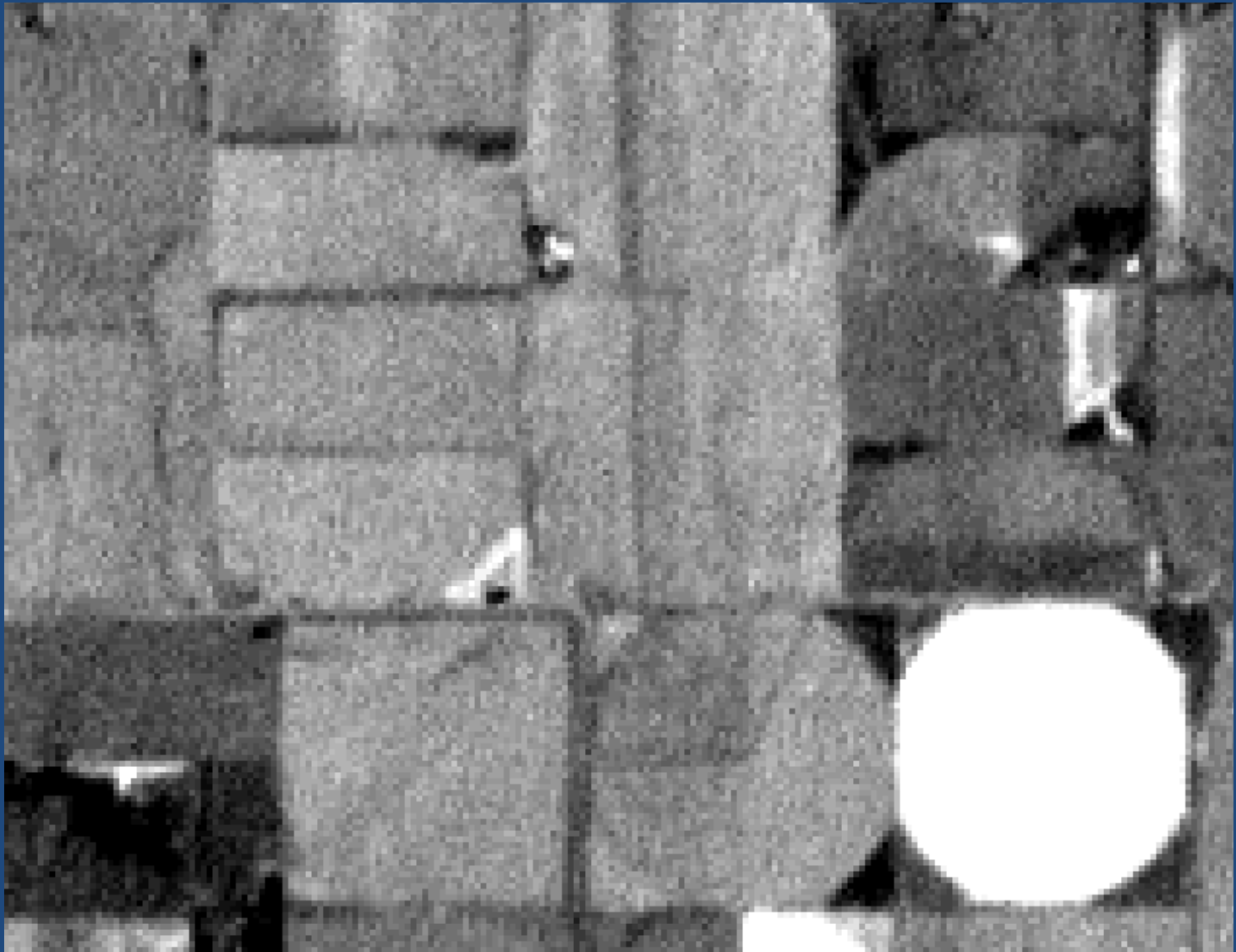
Blue band; Landsat 7



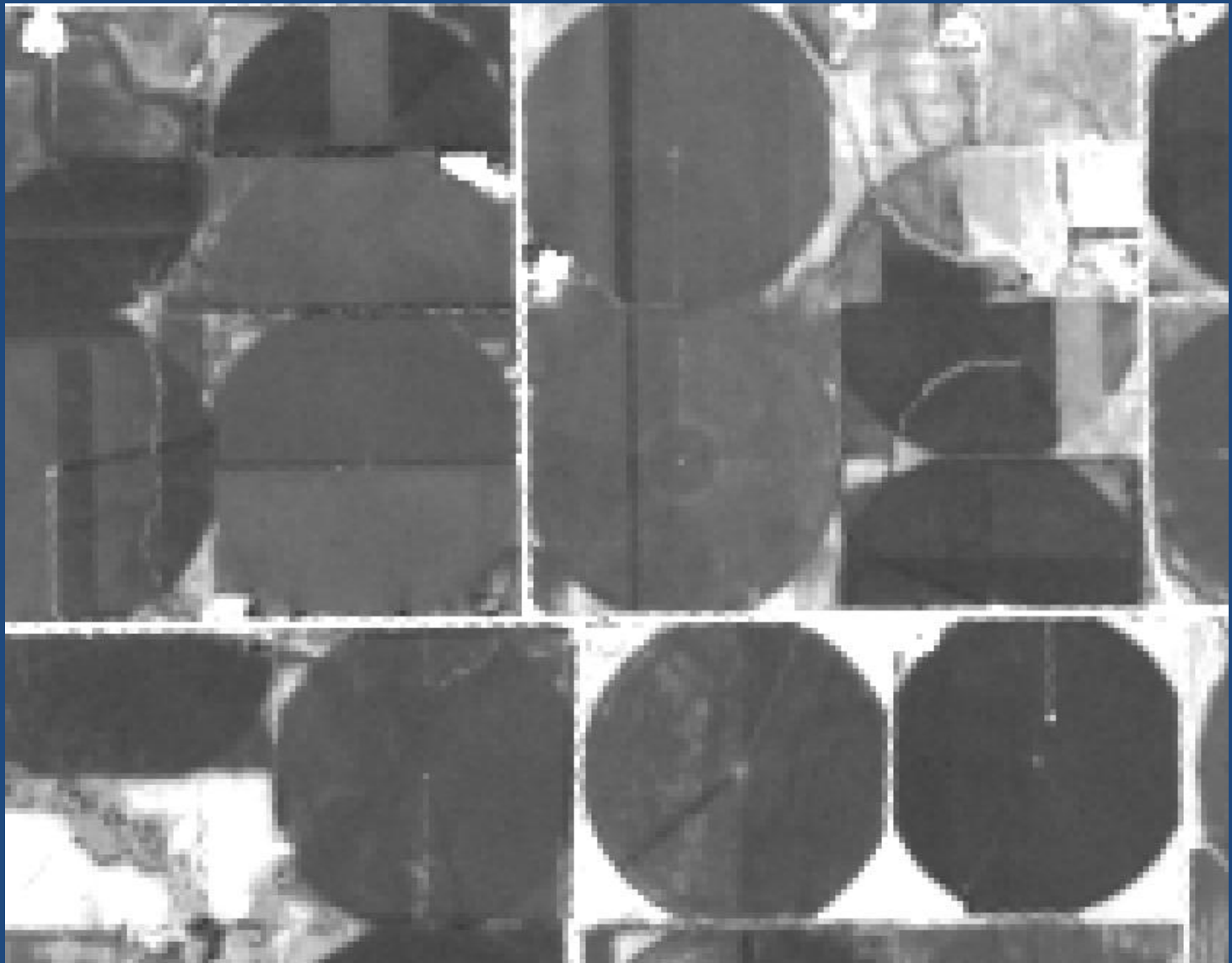
Blue band; Landsat 8



Pan band; Landsat 7



Pan band; Landsat 8



Conclusions

WOW!